STUDIUL UNOR SOIURI DE PRUN DE ORIGINE GERMANĂ ÎN CONDIȚIILE PEDOCLIMATICE DE LA ICDP PITEȘTI-MĂRĂCINENI

STUDY OF GERMAN PLUM CULTIVARS UNDER THE PEDOCLIMATIC CONDITIONS FROM RIFG PITESTI-MĂRĂCINENI

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Abstract

Given the importance of the plum culture in Romania and the fact that, year by year, the plum assortment is renewed with autochtonous and foreign cultivars, in this work we have proposed the study of 8 foreign cultivars resulting from the Germany breeding program ('Jojo', 'Haganta', 'Hanita', 'Topend plus', 'Topfive', 'Topfirst', 'Toptaste', 'Topgigant plus') considered very good from a quantitative and qualitative point of view in their country of origin. As a control 'Stanley' and 'Centenar' cvs. were used, widespread in the commercial orchards from Romania. The cultivars are located in a field trial established in 2018 within the Genetics and Breeding laboratory. The trees, grafted on the 'Mirobolan C5' rootstock, were planted at a distance of 4 m between rows and 3 m between the trees and the crowns were trained as flat open center. During the 2020-2022 period the following observations and determinations were carry out: flowering and ripening phenophases, yielding capacity in kg/tree, fruits quality (weight, flesh firmness, soluble solids content) and behaviour to Plum Pox Virus. Following the observations and determinations made, the 'Topfirst' cv. was noted by earliness (3rd decade of July), 'Jojo', 'Haganta', 'Topgigant plus' and 'Topfirst' through higher productions than the two cultivars taken as a control, 'Haganta', 'Topgigant plus', 'Jojo' and 'Topend plus' through very large fruits (over 50 g on average) and 'Jojo', 'Haganta' and 'Hanita' by resistance to Plum Pox Virus. These cultivars can be recommended for the extension in the commercial orchards from Romania, taking into account the requirements of the private fruit growers. Also, some of these cultivars can be used as genitors in breeding works.

Cuvinte cheie: soiuri de prun, producție, fenofaze, calitate fruct, rezistență la PPV.
Key words: plum cultivars, yield, phenophase, fruit quality, PPV resistance.

1. Introduction

Plum is the most important species in Romania, where the climatic conditions are favorable for the spread of plum cultivars belonging to the European group (Cociu et al., 1997). The area cultivated with plum in 2020 was 67,010 ha, which represents 48.63% of the area cultivated with fruit trees in our country (FAOSTAT, 2022).

The fruit production registered in 2020 was 757,880 t (11.31 t/ha), respectively 47.34% of all fruit production in our country (FAOSTAT, 2022).

The plum assortment is constantly changing according to the requirements of consumers and growers. The Romanian researchers have made considerable efforts to improve the plum assortment by creating new cultivars and introducing foreign cultivars, in order to improve the productive performances and fruit quality and modernize fruit growing sector.

Also, within sub-Measure 4.1.a. Investments in the fruit growing sector, projects for establish plum orchards have been approved on an area of about 300 ha, the requested cultivars being both Romanian and foreign, especially those of German origin.

Thus, German cultivars have been widely spread in the last years in the research center and private farms, being absolutely necessary their study in the pedo-climatic conditions from our country.

In Germany, plum breeding was carried out in two centers: Hohenheim University, Stuttgart and Geisenheim Research Station. In the Hohenheim University in Suttgart, the main objective was resistance to Plum Pox Virus and 18 new cultivars were created by Professor Walter Hartmann: 'Hanita', 'Katinka', 'Elena', 'Jojo' – the first plum cultivar immune to the Plum Pox Virus, 'Felsina', 'Tipala', 'Tegera', 'Presenta', 'Colora', 'Azura', 'Haganta', 'Haroma', 'Habella', 'Hanka', 'Juna', 'Jofela', 'Jolina' and 'Joganta'. At the Research Station of Fruit Growing Geisenheim, the main objective was fruit quality and 12 cultivars

were registered by Professor Helmut Jacob: 'Topfive', 'Topper', 'Topking', 'Tophit plus', 'Top 2000', 'Topfirst', 'Topstar plus', 'Toptaste', 'Topgigant plus', 'Topend plus' - for fresh consumption; 'Bellamira' and 'Miragrande' - for distillation (Butac, 2010, 2020; Butac et al., 2013; Milošević and Milošević, 2018; Hartmann, 1998, 2002, 2019; Hartmann and Neumüller, 2009; Jacob, 2002, 2007).

For this purpose, eight German plum cultivars were evaluated in a field trial from Research Institute for Fruit Growing (RIFG) Pitesti, Romania, in terms of flowering and ripening time, production, fruits quality and susceptibility to the Plum Pox Virus.

2. Material and methods

2.1. Plant material

This study included eighth German plum cultivars ('Jojo', 'Haganta', 'Hanita', 'Topend plus', 'Topfive', 'Topfirst', 'Toptaste', 'Topgigant plus'). This choice was due to the interest of growers for these cultivars, because of their resistance/tolerance to Plum Pox Virus and good fruits quality. As a control 'Stanley' and 'Centenar' cvs. were used, widespread in the commercial orchards from Romania. Cultivars were grafted on 'Mirobolan C5' rootstock (Table 1).

2.2. Field trial and climatic conditions

The field trial was carried out in the spring of 2018, in the Genetic and Breeding Department of RIFG Pitesti, Romania, at the village Mărăcineni (Central part of Romania - 44°53'56" Northern latitude, and 24°51'35" Eastern longitude).

The trees were planted at a distance of 4 m between the rows and 3 m between the trees. The experiment was carried out in a randomized block design, in 3 replications with 3 trees per variant. The trees were trained as open vase, under non-irrigated standard cultural practices.

Soil types prevailing in the field are medium-textured and heavy-clay soils, with low humus content.

The climate neighboring RIFG Pitesti is favorable for growing deciduous fruit species (including the plum). The average multi-annual temperature is 10.0°C, the maximum temperature is 38.8°C, whereas the minimum temperature is –24.4°C; total annual rainfalls recorded is 678 mm. The early autumn frosts usually occur at the end of October and the latest about mid April (Fig. 1).

2.3. Measurements

In 2020 - 2022 periods, the following measurements were carried out:

- phenological traits - flowering and ripening time - appreciated by noting the calendar date;
- behaviour at the Plum Pox Virus (PPV) was appreciated by assigning grades from 1 to 9: 1 – resistant; 2 – very little susceptible; 3 – little susceptible; 5 – intermediate; 7 – susceptible; 8 – very susceptible; 9 – extremely susceptible;
- fruits yield was determined by weighing the fruits on the tree (3 trees in 3 repetitions), in kg/tree;
- fruits weight was measured using an electronic weighing balance, in g;
- fruits firmness was measured with non-destructive penetrometer Qualitest HPE equipped with a plunger of diameter 0.10 cm^2, in HPE units;
- soluble solids content of the fruits was determined with a digital refractometer, in % Brix;
- malic acid content of the fruits was determined with the device Minititrator Hanna Instrument 84532, in % or mg/100 g fresh matter.

The determinations regarding the fruits quality were carried out on a number of three fruits in three repetitions per each cultivar.

2.4. Statistical analysis

For the statistical interpretation of the results, the data were included in an Excel database and then statistically interpreted with the SPSS 14.0 program, which uses the Duncan test (multiple t test) for a 5% statistical assurance. Correlation analysis was performed in order to determine the relationships among parameters studied.

3. Results and discussions

3.1. Flowering time

Flowering in Maracineni, Arges is usually in the 2nd decade of April (Table 2). Late flowering is very important for plum cultivars because late spring frosts may occur in early April (Gravite and Kaufmane, 2017).

Regarding the flowering of German plum cultivars we can observe that 'Jojo', 'Haganta' and 'Hanita' cvs. bloomed early (April, 11) and 'Topfirst', 'Toptaste' and 'Topgigant plus' cvs. bloomed later (April, 14). All German cultivars bloomed later than the 'Centenar' cv. – the second control. Excepted 'Jojo', 'Haganta' and 'Hanita' cvs. all the other cultivars bloomed at the same time or even a little later than the 'Stanley' cv. – the first control (Table 2).

The flowering season in 2020 was earlier (first decade of April) and short with negative influence of fruit set and yield due to the higher temperatures from February and March. The opposite conditions were

observed in 2021, when the flowering period was later (the end of the second decade of April). In 2022, the studied plum cultivars bloomed in mid-April.

Similar results regarding the flowering order of German cultivars were obtained by Molnar et al. (2017) for 'Topfive', 'Toptaste', 'Topend plus' and 'Jojo' cvs., as well as by Bozhkova and Savov (2018) for 'Jojo', 'Topgigant plus', 'Toptaste' and 'Stanley'. Stefanova and Popski (2020) report similar results for 'Topgigant plus' and 'Topend plus' cultivars and Sotirov et al. (2021) for 'Toptaste' and 'Stanley' cultivars.

3.2. Ripening time

Fruits of the studied cultivars ripen within a period of two month, from the end of July ('Topfirst' cv.) to the beginning of September ('Topend plus' cv.) (Table 3).

Thus, 'Topfirst' cv. ripened in the third decade of July (July, 20), 3 days earlier than 'Centenar' cv., known as an early ripening cultivar.

'Hanita' and 'Topfive' cvs. ripened in the first decade of August, 10-12 days later than 'Centenar' cv. 'Toptaste' cv. ripened in the second decade of August a week earlier than 'Stanley' cv.

The other cultivars, 'Topgigant plus', 'Jojo', 'Haganta' and 'Topend plus' ripened in the third decade of August and in the first decade of September respectively, belonging to the group of late ripening cultivars.

Our results regarding fruit ripening are in agreement with those obtained by other researchers in other areas of Europe (e.g. Jacob in Germany – 2002; Blazec and Pistekova, in Czech Republic – 2009; Bozhkova and Savov in Plovdiv, Bulgaria – 2016 and 2018; Stefanova and Popski in Troyan, Bulgaria - 2017; Kovacs et al. - 2012, Molnar et al. – 2016, Suranyi – 2019 in Hungary; Gravite et Kaufmane in Latvia – 2016).

3.3. Behaviour at Plum Pox Virus (PPV)

Plum Pox Virus, also called Sharka, is considered one of the most serious virus diseases of stone fruit in Europe. In Romania, Sharka causing great yield losses, especially to sensitive plum cultivars (Zagrai et. al., 2001).

The results confirmed those other authors (Hartmann, 1998, 2002; Jacob, 2007), who found that 'Jojo' had the best resistance to PPV. Also, 'Haganta' and 'Hanita' cvs. are resistant to PPV. Mild leave symptoms were observed at the cultivars 'Topfirst', 'Toptaste', 'Topfive' and 'Topend'. Strong fruits symptoms and mild leave symptoms were observed at 'Topgigant plus' cv. (Table 4).

'Stanley' cv. – the first control is medium sensitive to PPV, showing symptoms on leaves (note 5) and few symptoms on fruits (note 3). 'Centenar' cv. – the second control is sensitive to PPV, showing severe symptoms both on leaves and fruits (note 7).

3.4. Fruits yield

The trees of the majority of the cultivars came into bearing in the third year after planting (respectively, 2020), but the production was very low. Statistical analysis of data on yield per tree (kg/tree), using Duncan's multiple range test ($P \leq 0.05$), showed significant differences between the cultivars. The highest fruits yield recorded 'Haganta' cv. with 4.96 kg/tree, 'Topgigant plus' cv. with 4.46 kg/tree and 'Topfirst', cv. with 4.43 kg/tree and the lowest fruit production was recorded at 'Topfive' cv. (1.40 kg/tree on average) and 'Hanita' (2.44 kg/tree), between cultivars being very significant differences (Table 5).

Between the years of study there are very significant differences of production, yield per tree increasing from one year to another as expected in a young plum orchard.

It can be observed that the cultivars 'Haganta', 'Topgigant plus', 'Topfirst' and 'Jojo' had higher productions than 'Stanley' cv. known as one of the most productive plum cultivars.

Compared to 'Centenar' cv. – the second control, to the 4 previously mentioned cultivars, 'Toptaste' cv. is added with 2.99 kg/tree.

Our results confirmed the early onset of bearing and good yielding capacity of the German cultivars, characteristics reported by other authors as well Blazek and Pistekova in 2009, Stefanova and Popski in 2020, Sotirov et al. in 2021, etc.

3.5. Fruit characteristics

The results regarding fruit characteristics were similar to those obtained by other authors regarding German plum cultivars (Blazec and Pistekova, 2009; Kovacs et al., 2012; Bozhkova, 2014; Molnar et al., 2016; Gravite and Kaufmane, 2017; Bozhkova and Savov, 2018; Suranyi, 2019; Stefanova and Popski, 2020; Sotirov et al., 2021).

Fruit weight. An important factor in marketing of plum cultivars designated for fresh consumption is fruit size. Average fruit weight was determined by weighing 3 fruits in 3 replications in each of the three consecutive years. For German plum cultivars, the largest fruits were recorded 'Topgigant plus' (68.81 g) and 'Haganta' (62.79 g) and the lowest fruits had 'Topfive' (34.90 g), between cultivars being significant differences (Table 6). All German cultivars studied, except 'Topfive' cv., have larger fruits than 'Stanley' and 'Centenar' controls. Making a correlation between yield and fruit weight it is observed that there is a positive correlation. 'Topgigant plus' and 'Haganta' cvs. had large fruits and good yield and 'Topfive' cv. had small fruits and small production.

Flesh firmness. Firmness is an important factor in stone fruits often related to taste and shelf life, and firmness assessment is widely used both in the marketing chain to judge overall fruit quality and by researchers in variety testing and programs including fruit quality (Sekse and Wermund, 2010). Generally, flesh firmness decreases during the maturation and ripening (Crisosto, 1994). Early season plum cultivars (e.g. 'Topfirst', 'Topfive' and 'Hanita' are usually less firm at the minimum maturity time than late season cultivars (e.g. 'Topgigant plus', 'Jojo', 'Topend plus'). All German cultivars had very firm fruits. However, only 3 of them ('Jojo', 'Toptaste' and 'Topend plus') had firmer fruits than the two control cultivars – 'Stanley' and 'Centenar' (Table 7).

Fruit soluble solids content (SSC). Statistical analysis of data on fruit soluble solids content (%) showed significant differences between the cultivars. The German plum cultivars with the highest soluble solids content were 'Haganta' (22.18%), 'Topend plus' (20.20%), 'Toptaste' (19.88%), 'Hanita' (17.98%) and 'Topfive' (17.44%). The plum cultivar with the lowest soluble solids content was 'Topfirst' (14.51%) which is very early cultivar and do not accumulate enough sugar (Table 8).

Excepted 'Topfirst' cv., all other German cultivars had higher fruit soluble solids content than 'Stanley' cv. – the first control. 'Topfive', 'Hanita, 'Toptaste', 'Topend plus' and 'Haganta' cvs. had fruits richer in sugar than 'Centenar' cv. – the second control.

Malic acid content of plums varied between 0.58% at 'Topfive' cv. and 0.94% at 'Topgigant plus' cv. All the German cultivars had fruits with higher malic acid content than 'Stanley' and 'Centenar' controls (Table 9).

Minas et al., (2015) has found that plums were harvested at 27–35 N flesh firmness, soluble solids content was 11.1–19.7% and malic acid varied from 0.30 to 1.60%.

3.6. Correlations between the main traits

There are distinctly significant correlations between:

- fruit weight and yield (r=0.624**); fruit weight and soluble solids content (r=0.637**); fruit weight and firmness (r=0.414*); fruit weight and malic acid (r=0.705**); fruit soluble solids content and malic acid (r=0.432*); fruit soluble solids content and firmness (r=0.473**); firmness and malic acid (r=0.530**) (Table 10).

4. Conclusions

Following the observations and determinations made for three years, the following conclusions were reached:

- 'Topfirst' cv. was noted by earliness (3rd decade of July) and Haganta' and 'Topend plus' cvs. by lateness (first decade of September);
- 'Jojo', 'Haganta', 'Topgigant plus' and 'Topfirst' cvs. through higher productions than the two cultivars taken as a control;
- 'Haganta', 'Topgigant plus', 'Jojo' and 'Topend plus' cvs. were noted through very large fruits (over 50 g on average)
- 'Jojo', 'Haganta' and 'Hanita' cvs. were noted by resistance to PPV;
- 'Jojo' cv., although resistant to PPV, is sensitive to late spring frosts;
- 'Topgigant' cv., although it has good yields and very large fruits, is very sensitive to PPV;
- 'Toptaste' cv. has a balanced taste and PPV tolerance;
- 'Topfive' cv. has small yields and fruit, but high soluble solids content.

When establishing new plum orchards, growers should take into account the advantages and disadvantages of these cultivars and choose the right cultivar according to pedoclimatic adaptability and production destination.

Some of these cultivars have been introduced in the last 10 years in the Romanian breeding program and there are seedlings in the selection field, which will be studied in the next stages.

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Tables and Figures

Table 1. Biological material studied

No.	Cultivars	Origin	Year of registered
1	Topfirst	Čačanska Najbolja x Ruth Gerstetter	1993
2	Toptaste	Valor x German Prune	1994
3	Topfive	Čačanska Najbolja x Bühler Frühzwetsche Typ Weisenheim	1987
4	Topgigant Plus	Čačanska Najbolja x President	1994
5	Topend Plus	Čačanska Najbolja x Valor	1994
6	Jojo	Ortenauer x Stanley	1993
7	Haganta	Čačanska Najbolja x Valor	2003
8	Hanita	President x Auerbacher	1991
9	Stanley (Ct 1)	d`Agen x Grand Duke	1926
10	Centenar (Ct 2)	Tuleu gras x Early Rivers	1978

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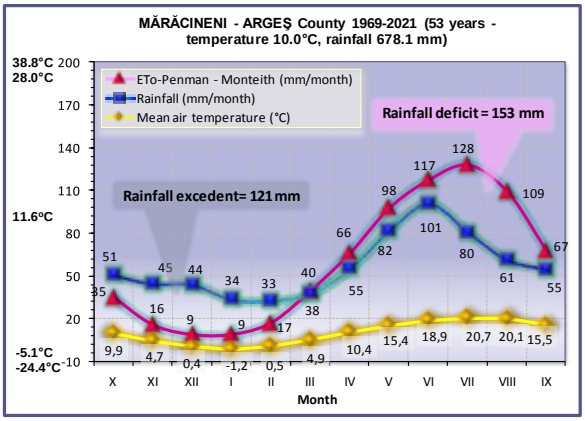

Fig. 1. The values of the main meteorological parameters in the Maracineni area, between 1969-2021

Table 2. Flowering time of plum cultivars studied during 2020-2022

No.	Cultivars	2020	2021	2022	Mean	Difference of Ct 1 (Day+/-)	Difference of Ct 2 (Day +/-)
1	Topfirst	7.04	20.04	14.04	**14.04**	+2	+5
2	Toptaste	6.04	18.04	14.04	**13.04**	+1	+4
3	Topfive	6.04	17.04	13.04	**12.04**	0	+3
4	Topgigant plus	6.04	18.04	14.04	**13.04**	+1	+4
5	Topend plus	6.04	18.04	13.04	**12.04**	0	+3
6	Jojo	5.04	16.04	12.04	**11.04**	-1	+2
7	Haganta	4.04	18.04	12.04	**11.04**	-1	+2
8	Hanita	4.04	18.04	12.04	**11.04**	-1	+2
9	Stanley (Ct 1)	4.04	16.04	12.04	**12.04**		
10	Centenar (Ct 2)	2.04	15.04	10.04	**9.04**		
	Average	**5.04**	**17.04**	**14.04**			

Table 3. Ripening time of plum cultivars studied

No.	Cultivars	July		August			September
		10-20	20-30	1-10	10-20	20-30	1-10
1	Topfirst	**20.07**					
2	Centenar (Ct 2)		**23.07**				
3	Hanita			**2.08**			
4	Topfive			**5.08**			
5	Toptaste				**14.08**		
6	Stanley (Ct 1)				**20.08**		
7	Topgigant plus					**22.08**	
8	Jojo					**25.08**	
9	Haganta						**2.09**
10	Topend plus						**5.09**

Table 4. Behaviour at the Plum Pox Virus of plum cultivars studied

No.	Cultivars	PPV	
		On leaf	On fruit
1	Topfirst	3	1
2	Toptaste	2	1
3	Topfive	3	1
4	Topgigant plus	8	3
5	Topend plus	3	1
6	Jojo	1	1
7	Haganta	1	1
8	Hanita	1	1
9	Stanley (Ct 1)	5	3
10	Centenar (Ct 2)	7	7

Table 5. Fruits yield of plum cultivars studied during 2020-2022 (Kg/tree)

No.	Cultivars	2020*	2021*	2022*	Average (2020-2022)*
1	Topfirst	2.53 ab	4.41 b	6.36 b	4.43 ab
2	Toptaste	1.45 cd	2.83 d	4.69 c	2.99 bcd
3	Topfive	0.46 e	1.34 f	2.40 f	1.40 d
4	Topgigant plus	2.12 b	4.35 b	6.90 a	4.46 ab
5	Topend plus	1.01 d	2.32 e	3.75 e	2.36 cd
6	Jojo	1.58 c	3.50 c	6.23 b	3.77 abc
7	Haganta	2.75 a	5.06 a	7.07 a	4.96 a
8	Hanita	1.33 cd	2.21 e	3.78 e	2.44 cd
9	Stanley (Ct 1)	2.32 ab	3.29 c	4.88 c	3.50 abc
10	Centenar (Ct 2)	1.11 d	2.24 e	4.27 d	2.54 cd
	Average	**1.67**	**3.15**	**5.03**	**3.28**

*Duncan multiple ranges test. Mean values followed by the same letter within a column are not significantly different (P≤0.05).

Table 6. Fruits weight of plum cultivars studied during 2020-2022 (g)

No.	Cultivars	2020*	2021*	2022*	Average (2020-2022)*
1	Topfirst	48.73 c	49.27 abcd	49.83 cde	49.28 bc
2	Toptaste	47.60 c	36.60 d	49.97 cde	44.72 c
3	Topfive	26.50 d	38.76 cd	39.43 f	34.90 d
4	Topgigant plus	68.90 a	63.60 a	73.93 a	68.81 a
5	Topend plus	52.93 bc	56.23 abc	52.53 c	53.90 b
6	Jojo	50.93 bc	47.57 abcd	51.56 cd	50.02 bc
7	Haganta	64.33 ab	59.83 ab	64.20 b	62.79 a
8	Hanita	44.93 c	46.06 abcd	45.40 def	45.46 c
9	Stanley (Ct 1)	45.63 c	43.67 bcd	43.70 ef	44.33 c
10	Centenar (Ct 2)	47.87 c	47.83 abcd	46.00 de	47.23 bc
	Average	**49.83**	**48.94**	**51.65**	**50.14**

*Duncan multiple ranges test. Mean values followed by the same letter within a column are not significantly different (P≤0.05).

Table 7. Fruits firmness of plum cultivars studied during 2020-2022 (HPE units)

No.	Cultivars	2020*	2021*	2022*	Average (2020-2022)*
1	Topfirst	63.13 a	58.43 b	55.53 d	59.03 c
2	Toptaste	73.90 a	81.27 a	74.37 a	76.51 a
3	Topfive	34.17 b	57.70 b	46.60 e	46.15 d
4	Topgigant plus	59.30 ab	63.53 b	62.23 bcd	61.69 c
5	Topend plus	71.43 a	81.83 a	69.77 ab	74.34 ab
6	Jojo	66.53 a	61.37 b	73.93 a	67.28 abc
7	Haganta	47.20 ab	63.27 b	64.97 abc	58.48 c
8	Hanita	60.07 ab	57.67 b	57.87 cd	58.53 c
9	Stanley (Ct 1)	66.00 a	66.90 b	72.73 a	68.54 abc
10	Centenar (Ct 2)	62.67 a	65.63 b	69.53 ab	65.94 bc
	Average	**60.44**	**65.76**	**64.75**	**63.65**

*Duncan multiple ranges test. Mean values followed by the same letter within a column are not significantly different (P≤0.05).

Table 8. Soluble solids content of the fruits of plum cultivars studied during 2020-2022 (%Brix)

No.	Cultivars	2020*	2021*	2022*	Average (2020-2022)*
1	Topfirst	14.17 ab	13.96 e	15.40 ef	14.51 e
2	Toptaste	19.73 ab	19.83 b	20.07 bc	19.88 b
3	Topfive	13.17 b	20.23 b	18.93 c	17.44 cd
4	Topgigant plus	15.77 ab	16.23 d	15.33 ef	15.78 cde
5	Topend plus	19.56 ab	20.36 b	20.67 b	20.20 ab
6	Jojo	14.60 ab	17.73 b	14.33 f	15.55 de
7	Haganta	21.27 a	22.30 a	22.97 a	22.18 a
8	Hanita	17.37 ab	19.33 b	17.23 d	17.98 bc
9	Stanley (Ct 1)	14.23 ab	14.46 e	15.53 ef	14.74 e
10	Centenar (Ct 2)	15.90 ab	17.20 cd	16.73 de	16.61 cde
	Average	**16.58**	**18.16**	**17.72**	**17.49**

*Duncan multiple ranges test. Mean values followed by the same letter within a column are not significantly different (P≤0.05).

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Table 9. Malic acid content of the fruits of plum cultivars studied during 2020-2022 (% or mg/100 g fresh matter)

No.	Cultivars	2020*	2021*	2022*	Average (2020-2022)*
1	Topfirst	0.88 ab	0.93 b	0.89 a	0.90 a
2	Toptaste	0.67 bcd	0.64 d	0.64 d	0.65 cd
3	Topfive	0.45 d	0.62 d	0.67 cd	0.58 de
4	Topgigant plus	0.85 ab	1.04 a	0.92 a	0.94 a
5	Topend plus	0.73 abc	0.75 c	0.76 b	0.75 b
6	Jojo	0.96 a	0.90 b	0.88 a	0.91 a
7	Haganta	0.71 bc	0.70 cd	0.72 bc	0.71 bc
8	Hanita	0.69 bcd	0.67 cd	0.68 cd	0.68 bc
9	Stanley (Ct 1)	0.63 bcd	0.62 d	0.64 d	0.63 cd
10	Centenar (Ct 2)	0.54 cd	0.51 e	0.55 e	0.53 e
	Average	**0.71**	**0.74**	**0.73**	**0,73**

*Duncan multiple ranges test. Mean values followed by the same letter within a column are not significantly different (P≤0.05).

Table 10. Correlation coefficients r obtained between parameters studied

r	Yield (kg/tree)	Fruit weight (g)	SSC (% Brix)	Firmness (units HPE)	Malic acid (g/100 g fresh matter)
Yield (kg/tree)	x	0.624**	0.192	0.142	0.495**
Fruit weight (g)	0.624**	x	0.637**	0.414*	0.705**
SSC (% Brix)	0.192	0.637**	x	0.473**	0.432*
Firmness (units HPE)	0.142	0.414*	0.473**	x	0.530**
Malic acid (mg/100 g fresh matter)	0.495**	0.705**	0.432	0.530**	x

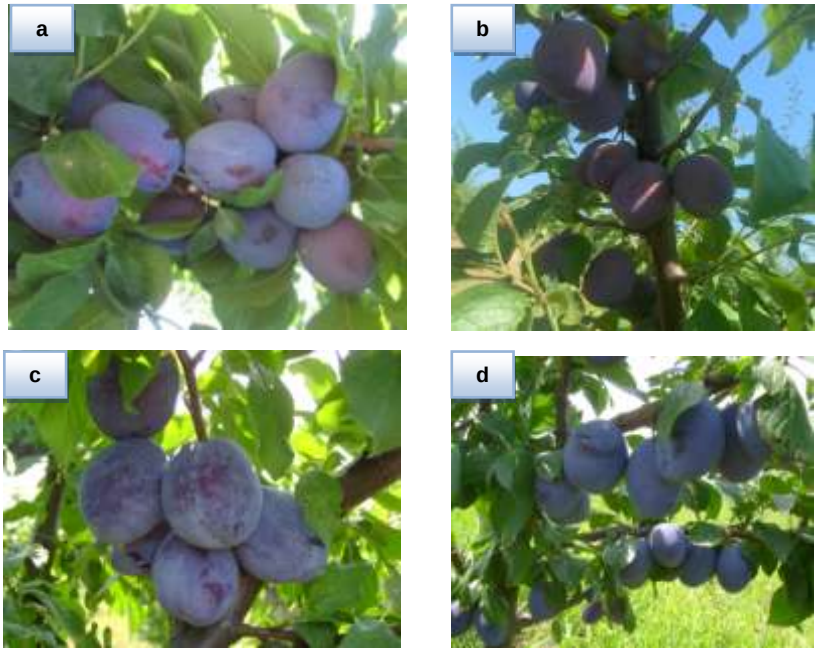

Photo 1. Plum cvs. studied: a - 'Topfirst', b - 'Toptaste', c - 'Haganta', d -'Jojo'