

BEHAVIOUR OF SOME PLUM CULTIVARS UNDER ECOLOGICAL CONDITIONS FROM ARGES AREA

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Abstract

In last year's, as a result of the biological material exchange with different fruit growing institutes from Europe, a large number of plum varieties have been introduced into the culture. The aim of this study was to evaluate the behaviour of some plum varieties with different origins (Belarus, Russia, Estonia and USA) in the climatic conditions of Maracineni, Arges area. In 2016-2018 periods, at 13 plum varieties ('Kometa', 'Vilnor', 'Kadri', 'Nesmeyana', 'Lama', 'Soneyka', 'Dalikatnaya', 'Asloda', 'Okskaya', 'Wanette', 'Mirnaya', 'Vengherka Kaukaskaya', 'Vengherka Belaruskaya') were evaluated phenological traits (flowering and ripening time) and some fruits characteristics (shape, colour, weight, soluble solids content, titratable acidity and firmness). The most plum varieties studied were characterized by early flowering (about 7 days earlier than most plum varieties cultivated in Romania) and early ripening (the first two decade of July). The skin color varied from yellow ('Soneyka' cv) to blue ('Vilnor', 'Kadri', 'Okskaya', 'Wanette', 'Vengherka Kaukaskaya', 'Vengherka Belaruskaya' cvs.). The 'Lama' variety was noted by skin and flesh red of fruits. The average fruit weight ranged from 22.21 g ('Kometa' cv.) to 50.41 g ('Vengherska Beloruskaya' cv.). The following varieties were noted for large fruits (over 40 g): 'Lama', 'Dalikatnaya', 'Asaloda', 'Okskaya', 'Mirnaya', 'Vengherka Kaukaskaya' and 'Vengherka Belaruskaya'. The 'Soneyka' and 'Vengherka Kaukaskaya' were clearly differentiated by firmness (64.0 N, respectively 56.06 N), while the 'Wanette' and 'Mirnaya' cvs. were differentiated by the high content in soluble solids (19.25% respectively 18.75% Brix).

Key words: plum, cultivars, phenological traits, fruits characteristics.

INTRODUCTION

Plum is the most important species in Romania. The average annual production of 481.278 t in the period 2015-2017 ranks Romania on the second place in the world, after China (FAOSTAT 2019). Although most of the production is intended for processing, the interest for the consumption of fresh fruits is constantly increasing (Milatovic et al., 2018). Therefore, the improvement of the plum assortment was a primary concern in Romania, and implicitly at the Research Institute for Fruit Growing Pitesti-Maracineni. This is why, at RIFG Pitesti Maracineni, besides the activity of creating new varieties another objective is to introduce the new foreign cultivars and their study in Romanian climatic and soil conditions

in order to choose and spread the better cultivars in the region of Arges district (Butac, 2015). For this purpose, in the period 2010-2014 in our institute were carried out 4 bilateral projects with the Institute for Fruit Growing Minsk, Belarus, occasion with which there were made reciprocal exchanges of biological material. Thus, 13 plum varieties of different origins (Belarus, Russia and the Baltic countries) were evaluated in a field trial, from a phenological and qualitative point of view.

MATERIALS AND METHODS

The studies were carried out in a field trial located at the RIFG Pitesti Maracineni, Genetics and Breeding Laboratory on a number of 13 plum varieties, which have not been cultivated in

Romania, obtained following a bilateral scientific program with Institute for Fruit Growing Minsk - Belarus carried out during the period 2010-2014 (Table 1). The trees, grafted on 'Myrobalan' rootstock were planted in the spring of 2015, at a distance of 4 x 3 m, under non-irrigation conditions.

At these varieties the following traits were evaluated:

- phenological traits - flowering and ripening time - were appreciated by noting the calendar date;
- fruit color appreciated visually;

- fruit weight was recorded with a balance in g/fruit;
 - soluble solid contents were measured with a portable refractometer, in % Brix;
 - fruit firmness was measured with non-destructive penetrometer Qualitest HPE equipped with a plunger of diameter 0.10 cm²;
 - fruit content in malic acid of fruits were measured using the device Minitalator and pH meter for fruit juice - Hanna Instrument 84532. Titratable acidity is expressed as g/100 g fresh matter.
- Data were analyzed statistically using Duncan's multiple range test - $P < 0.05$.

Table 1. Biological material studied

No	Varieties	Origin	Type of species	Year of registered in Belarus
1	Lama*	Belarus, Hybrid 9-250 (<i>P. cerasifera</i> var. <i>Pissardii</i>) open pollination	Diploid	2003
2	Asaloda*	Belarus, hybrid (<i>P. cerasifera</i> × <i>P. ussuriensis</i>) × <i>Puteshestvennitsa</i>	Diploid	2003
3	Dalikatnaya*	Belarus, Evrasia 21 × d'Agen	Hexaploid	2005
4	Soneyka*	Belarus, Mara open pollination	Diploid	2015
5	Vengherka Belaruskaya*	Belarus, Stanley × Dalikatnaya	Hexaploid	2015
6	Vilnor**	Estonia, Wilhelmina Späth × Noarootsi Punane	Hexaploid	1989
7	Kadri**	Estonia, Latvijas Dzelteno Olplumi × Suhkruploom	Hexaploid	1994
8	Kometa (Kometa kubanskaya)**	Russia, Skoroplodnaia × Pionerka	Diploid	1999
9	Mirnaya*	Russia, Skorospelka Krasnaya × Reine Claude de Bavay	Hexaploid	2013
10	Vengherka Kaukaskaya*	Russia, Reine Claude d'Althan × Sochinskaya yubileinaya	Hexaploid	-
11	Nesmeyana*	Russia, Kometa kubanskaya open pollination	Diploid	2005
12	Okskaya**	Russia, Severyanka × Record	Hexaploid	-
13	Wanette	USA, <i>P. americana</i> × <i>P. ussuriensis</i> or <i>P. salicina</i>	Diploid	-

*Kazlouskaya et al., 2015; **James and Pae, 1998; Karklins et al., 2007.

RESULTS AND DISCUSSIONS

Phenological traits

Flowering time. Usually in Romania plum blooms in mid-April depending on weather conditions. Average flowering time of studied cultivars was in the first decade of April (Table 2). The earliest start of flowering was recorded at the 'Dalikatnaya', 'Soneyka', 'Kometa', 'Nesmeyana' cvs. (April, 1) and the latest at the 'Kadri' cv. (April, 7). The average difference between cultivars with earliest and latest flowering was seven days. The earliest flowering was in 2017 (average March, 28) and the latest flowering was in 2019 (Average April, 11). The average difference between

years with earliest and latest flowering was 14 days much bigger than difference between cultivars. We can see that diploid cultivars blossomed earlier than hexaploid cultivars. This characteristic exposing them to the risk of late spring frosts which usually appear till middle of April.

Ripening time. Most of the plum varieties studied were very early (starting July 1 to 31), with the exception of the 'Vengherka Belaruskaya', 'Vengherka Kaukaskaya' and 'Mirnaya' varieties that matured on August 15.

Cv. 'Dalikatnaya' was studied also in Serbia where the same results were obtained (Milatovic et al., 2018).

Table 2. Phenological characteristics of plum cultivars (average, 2017-2019)

No.	Varieties	Flowering time	Abundance of flowering (0-5 scale)	Ripening time
1	Lama	3 April	2	13 July
2	Asaloda	4 April	5	13 July
3	Dalikatnaya	1 April	5	13 July
4	Soneyka	1 April	5	15 July
5	Vengherska Belaruskaya	5 April	4	15 August
6	Vilnor	4 April	4	1 July
7	Kadri	7 April	3	1 July
8	Kometa	1 April	5	1 July
9	Mirnaya	5 April	4	15 August
10	Vengherka Kaukaskaya	5 April	3	15 August
11	Nesmeyana	1 April	5	1 July
12	Okskaya	5 April	2	15 July
13	Wanette	5 April	3	31 July
	<i>Amplitude</i>	<i>01 -14.04</i>	<i>2-5</i>	<i>1.07-15.08</i>

Physical fruits characteristics

Fruit shape of plum varieties studied varied from spherical (Lama, Dalikatnaya, Vilnor, Kometa, Mirnaya), ovate (Asaloda, Soneyka, Kadri, Okskaya, Wanette) to elongated spherical (Vengherka Belaruskaya, Vengherka Kaukaskaya, Nesmeyana) (Table 3).

Skin colour varied from yellow ('Soneyka') to blue ('Vilnor', 'Kadri', 'Okskaya', 'Wanette', 'Vengherka Kaukaskaya', 'Vengherka Belaruskaya'). The 'Lama' variety was noted by skin and flesh red of fruits (Table 3).

Stone adherence. 6 varieties are freestone, 5 are semi-adherent, and only 2 have pulp-adherent (Table 3).

Table 3. Fruits characteristics: shape, colour, stone adherence

No.	Varieties	Shape	Colour	Stone adherence
1	Lama	Spherical	Reddish	Freestone
2	Asaloda	Ovate	Reddish	Semi-adherent
3	Dalikatnaya	Spherical	Red violet	Freestone
4	Soneyka	Ovate	Yellow	Semi-adherent
5	Vengherka Belaruskaya	Elongated Spherical	Blue	Semi-adherent
6	Vilnor	Spherical	Blue	Clingstone
7	Kadri	Ovate	Blue	Freestone
8	Kometa	Spherical	Reddish	Semi-adherent
9	Mirnaya	Spherical	Reddish	Freestone
10	Vengherka Kaukaskaya	Elongated Spherical	Blue	Freestone
11	Nesmeyana	Elongated Spherical	Reddish	Semi-adherent
12	Okskaya	Ovate	Blue	Clingstone
13	Wanette	Ovate	Blue	Freestone

Fruits weight. An important role in marketing for plum varieties designated for fresh consumption has fruit size. The largest fruits were recorded 'Vengherka Belaruskaya' (50.41 g) and 'Lama' (47.98 g), values which differ very significantly and significantly from the other varieties studied. At early varieties, the fruit weight not exceed 31 grams ('Kometa' - 22.21 g, 'Vilnor' - 25.3 g, 'Nesmeyana' - 31.3 g), while at later varieties (e.g. 'Vengherka Belaruskaya') the fruit weight reaches 50.41 grams (Table 4).

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. Early season plum varieties are usually less firm at the minimum maturity time than late season varieties (Crisosto, 1994). The varieties with the highest flesh firmness were 'Vengherka Belaruskaya' (46.83 N), 'Lama' (47.98 N), 'Vengherka Kaukaskaya' (56.06 N) and 'Soneyka' (67.00 N) (Table 4).

Fruit soluble solids content increases with maturity and ripening and could be a good quality

index. The soluble solids content ranged from 11.08 % at ‘Kometa’ cv. to 19.25 % at ‘Wanette’ cv. The varieties with the highest soluble solids content were ‘Dalikatnaya’ (15.20%), ‘Okskaya’ (16.53%), ‘Kadri’ (16.83%), ‘Mirnaya’ (18.75%) and ‘Wanette’ (19.25%) (Table 4).

Titrateable acidity of plums varied between 0.11g malic acid at ‘Soneyka’ cv. and 0.59 g

malic acid at ‘Okskaya’ cv. It is observed that the acid content has a correlation with the skin color: fruits with light color have a low acid content, while fruits with dark color have a high acid content.

Minas et al. (2015) has found that plums were harvested at 27-35 N flesh firmness, SSC was 11.1-19.7% and TA varied from 0.30 to 1.60%.

Table 4. Fruits characteristics of plum varieties studied (2017-2018)

No.	Variety	Fruit weight (g)	Firmness (N or HPE units)	Soluble solid contents - SST (% Brix)	Titrateable acidity - TA (Acid malic %)
1	Lama	47.98 a	49.65 b	13.21 de	0.29 cd
2	Asaloda	40.25 b	30.45 cd	12.80 e	0.47 b
3	Dalikatnaya	41.31 b	31.00 cd	15.20 bc	0.36 c
4	Soneyka	32.85 c	67.00 a	13.95 cde	0.11 g
5	Vengherka Belaruskaya	50.41 a	46.83 b	13.63 de	0.22 def
6	Vilnor	25.33 d	19.50 e	14.61 cd	0.52 ab
7	Kadri	30.06 c	37.15 c	16.83 b	0.28 cd
8	Kometa	22.21 e	30.01 cd	11.08 f	0.12 g
9	Mirnaya	40.68 b	23.41 de	18.75 a	0.28 de
10	Vengherka Kaukaskaya	41.93 b	56.06 b	14.55 cd	0.13 fg
11	Nesmeyana	31.93 c	26.93 cde	11.20 f	0.15 efg
12	Okskaya	40.95 b	25.05 de	16.53 b	0.59 a
13	Wanette	24.95 de	30.26 cd	19.25 a	0.34 c

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



Figure 1. Pictures with some cultivars studied (a - Okskaya; b - Lama; c -Asaloda; d - Dalikatnaya; e - Soneyka)

CONCLUSIONS

The most plum varieties studied were characterized by early flowering (about 7 days earlier than most plum varieties cultivated in Romania) and early ripening (the first two decade of July).

The skin color varied from yellow (‘Soneyka’ cv) to blue (‘Vilnor’, ‘Kadri’, ‘Oksana’, ‘Wanette’, ‘Vengherka Kaukaskaya’, ‘Vengherka Belaruskaya’ cvs.). The ‘Lama’ variety was noted by skin and flesh red of fruits.

The average fruit weight ranged from 22.21 g (‘Kometa’ cv.) to 50.41 g (‘Vengherka Belaruskaya’ cv.).

The following varieties were noted for large fruits (over 40 g): ‘Lama’, ‘Dalikatnaya’, ‘Asaloda’, ‘Okskaya’, ‘Mirnaya’, ‘Vengherka Kaukaskaya’ and ‘Vengherka Belaruskaya’.

The ‘Soneyka’ and ‘Vengherka Kaukaskaya’ were clearly differentiated by firmness (64.0 N, respectively 56.06 N), while the ‘Wanette’ and ‘Mirnaya’ cvs. were differentiated by the high content in soluble solids (19.25%, respectively 18.75% Brix).

The studied plums varieties had physical and chemical properties which make them suitable to be grown in Romania. A few cultivars might be less accepted for fresh consumption due to their low soluble solids content, but they can compensate easily by the early fruit ripening. Although it is not an option for the current Romanian market, red or yellow plums are an important source of genes and diversity while waiting for a change in the taste of the Romanian consumer.

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