

## **DIVERSITATEA GENETICĂ A UNOR SOIURI DE PRUN OBȚINUTE DIN SOIUL 'TULEU GRAS'**

### **GENETIC DIVERSITY IN SELECTED PROGENY OF PLUM CULTIVAR 'TULEU GRAS'**

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#### **Abstract**

Becoming from several species and influenced by the very varied climate and soil conditions that characterize the Romanian territory, the plum has developed in this area numerous biological forms with a wide range of characters and characteristics. Taking into account these realities, fruit growers have selected valuable forms with an amazing diversity in terms of taste, size, productivity, ripening season, resistance to biotic and abiotic factors. Of these, the 'Tuleu gras' variety, due to its high plasticity and fruit quality, was very widespread in orchards in Romania and was used as parent in the autochthonous plum breeding since the second half of the last century, representing a numerous source of genes. Thus, by using this variety in breeding works, so far 23 varieties with a great genetic diversity have been registered. The aim of this paper was to study the phenotypic variability of some of these descendants. Thus, many varieties created in this way from 'Tuleu gras' ('Piteștean', 'Centenar', 'Tita', 'Roman') certainly recorded a genetic gain in almost all objectives, being in turn used as parents in the current works plum improvement.

**Cuvinte cheie:** prun, genitori, descendenți, variabilitate fenotipică.

**Key words:** plum, genitors, descendants, phenotypic variability.

#### **1. Introduction**

As in other European countries, plum breeding in Romania started from the idea of improving the characteristics of some old local varieties, rustic and very well adapted to the climatic conditions specific to the area. Although most indigenous varieties were intended for distillation (due to characteristics that made them less suitable for fresh consumption: pulp lacking firmness, high dry matter content and lack of acidity, clingstone fruits), still some of them have proven to have high valence for fresh consumption as well.

Thus, since the first phase of this program in the 50'-60 'of the last century, 'Tuleu gras' was one of the varieties for which Romanian researchers have recognized its valuable characteristics, being until today one of the most prolific sources of genes that has been the basis for obtaining 23 new very valuable plum varieties, some recognized and cultivated in foreign countries with a tradition in plum cultivation: 'Piteștean' in Germany and Poland, 'Carpatin' in the Czech Republic and Poland, 'Tuleu timpuriu' in Bulgaria, 'Tita' in the Netherlands (Butac et al., 2010; Butac et al., 2011).

#### **2. Material and methods**

The data were collected in the period 2018-2020 from an experimental plot of plums established in 2015. The trees were planted at a distance of 4/3, spindle canopy system, without irrigation. Along with 'Tuleu gras' cv., 4 other cvs. from it were also studied, respectively 'Centenar', 'Piteștean', 'Tita' and 'Roman'. The experiment was organized according to the block method in 3 repetitions with 6 trees per repetition.

In plum breeding programs, both in Romania and in other large plum-growing countries, 3 main directions were imposed: the extension of the consumption season, the quality of the fruits and the resistance to PPV.

As the PPV resistance gene was not detected in plums, only genitors with different levels of tolerance to some viral strains were known, and to achieve this objective the work of selection and fixation of tolerance is quite difficult, in this paper we treated the first 2 objectives of those mentioned above.

The harvesting time was established by the transformation in number of days from February 1, approximately the landmark indicator cherry tree from imposed dormancy (Drăgoi, 2000).

Biometric data for characterizing fruit quality were obtained by measuring 30 fruits / variety harvested in the morning, at full maturity and analyzed within a maximum of 2 hours after harvest, as follows: fruit weight in g; fruit firmness was measured using a non-destructible penetrometer (Bareiss Qualitest HPE); the skin color was assessed using the Konica Minolta CR 400 chromameter. In the CIELAB system, color is represented by the use of coordinates in a uniform color space consisting of the brightness variable  $L^*$  and the chromaticity indices  $a^*$  and  $b^*$ . Thus, if the  $L^*$  coordinate provides information on the brightness, the positive values of  $a^*$  are on the red axis and the negative ones on the green axis, and the positive values of  $b^*$  are on the yellow axis and the negative ones on the blue axis; the dry matter content was determined using the Hanna HI 96801 portable refractometer; pH and total acidity expressed in malic acid were determined using the Hanna HI 84532 mini-titrator.

### 3. Results and discussions

Regarding the **time of harvest**, not statistically sustained difference was created, the average for the 3 years of the number of days from February 1 until harvest being between 177 at 'Piteștean' and 182 at 'Roman' cv. (Table 1). This period corresponds on average between July 27 and August 1, and practically represents for the climatic conditions of the area the beginning of the period of harvesting plums for fresh consumption.

Very important for the commercial aspect, and here we refer to consumption of fresh fruit, the size of the fruit is evaluated on the basis of several benchmarks, the most important of which being the average **weight**. For consumers, and consequently also an improvement target, fruits over 40g (generally between 40 and 50 g) are considered appropriate.

Regarding this feature, 'Tuleu gras' was surpassed by his descendants both on average over the 3 years of study and each year (Table 2), with one exception in 2020, when 'Piteștean' cv. presented values close to it (33.1 g compared to 32.2 g for 'Tuleu gras' cv.).

'Tita' cv. had the largest fruits (in terms of their weight), in 2020 the average weighted sample was 69.2 g, and 'Tuleu gras' cv. had the smallest fruits (31.0 g, values measured in 2018).

In the average of the 3 years, 'Roman' and 'Tita' cvs. had the highest values in terms of fruit weight (56.1 g and 55.5 g respectively), followed by 'Centenar' and 'Piteștean' cvs. (38.9 g and 39.9 g), and the lowest values were recorded for 'Tuleu gras' cv.

For fresh consumption, **firmness** is an important feature, with a direct impact on increasing the resistance of fruit to handling and transport. 'Tuleu gras' cv. proved to be a good parent for this characteristic (on the average of the 3 years 'Tuleu gras' cv. showed the highest firmness with 51.3 HPE together with 'Centenar' cv. with 51.1 HPE), all progenies showing average of firmness values over the three years good and very good (Table 2). Thus, as mentioned above, the strongest ones proved to be 'Tuleu gras' and 'Centenar' cvs. with statistically differentiated values only from the 'Tita' cv. (41.4 HPE), while the firmness of the cvs. 'Piteștean' and 'Roman' cvs. (44.7 HPE, and 45.9 HPE respectively) did not present values that would statistically differentiate them from the two groups.

In plum breeding, 'Tita' cv. is often given as an example of a source of genes for improving fruit firmness.

Regarding the **skin color**, for the brightness variable  $L^*$ , the variations are quite small, both in relation to the multiannual average and for each variety and year, especially since the measurement of the samples was done without removing the epicuticular wax (Table 4).

In the case of the chromaticity index  $a^*$ , the values constantly high for the 'Tuleu gras' cv. are observed quite clearly, both on a multiannual average over the 3 years of study (9.75) and annually (17.98 in 2018, 5.16 in 2019 and 6.12 in 2020) which shows the presence of a reddish hue, more accentuated in this variety.

Significant differences were noticed in the case of the chromatic indicator  $b^*$ , which in the case of the cvs. 'Piteștean' in 2018 and 2020 (-3.36 respectively -6.44) and 'Centenar' in 2019 (-6.48).

**Taste**, both for the consumer and in the process of improvement is one of the main selection criteria, at the same time being the most difficult to analyze due to the complexity of its components. The basis of taste, however, consists of acids (which in fruits are represented almost exclusively by malic acid, expressed as a percentage or by the pH of the juice) and sugars.

Analyzing the **total soluble content** of the 5 cvs., it is observed that the annual average produced a high diversity (Table 4). We find the highest soluble content, as we expected, in 'Tuleu gras' cv. with 14.1%, but also 'Roman' cv. with 12.6%, and the lowest in 'Centenar' cv. 10.7 %, while the total soluble content values for 'Piteștean' and 'Tita' cvs. were 12.4 % and 11.4 %, respectively. However, in 2020, although the values of the total soluble content varied between 12.3 % for the 'Centenar' cv. and 13.8 % for 'Tita' cv., it was not enough to create a difference between the 5 varieties to be statistically assured.

The best accumulation of total soluble content was registered at 'Tuleu gras' cv. in 2019 (15.7 %), and the lowest at 'Centenar' cv. (8.4 %) in the measurements of the same year.

The values of **total acidity**, by the multiannual average, did not produce statistically sustained differences except between the cvs. 'Piteștean' 0.46 g/100 ml malic acid and 'Centenar' 0.32 g/100 ml (Table 4).

'Piteștean' cv. also recorded the highest values of malic acid of all 5 varieties (0.86 g/100 ml in 2020), while in 2018 'Centenar' cv. had its lowest values (0, 17 g/100 ml).

Regarding the **pH**, although it varied from 3.4 in 'Tita' cv. 2019 to 5.8 in 'Roman' cv. in 2020, the multiannual averages did not exceed the value of 5, a value considered rather suitable for fruit for processing in the form of juices. Thus, the pH of the studied cvs., as multiannual averages, had the following values: 4.5 for 'Tita' and 'Piteștean' cvs., 4.7 for 'Centenar' cv. and 4.8 for 'Tuleu gras' and 'Roman' cvs. without realizing any statistically sustained difference.

#### 4. Conclusions

The use in breeding programs old valuable varieties, such as 'Tuleu gras', can create diversity and even one valuable enough to form the basis for obtaining new varieties. In the present experiment it was observed that although for some characters the variations were small, for others notable differences were found.

Regarding the ripening period for the 4 descending cultivars from 'Tuleu gras' there is no high diversity, the time of harvest being only a few days away, the notable differences of 28-33 days earlier still exist between their and the 'Tuleu gras' cv. harvest time, depending on the cv. ('Roman' 28 days, 'Piteștean' 33 days).

The above data show that, by choosing valuable paternal parents with an early ripening period, an advance of approximately one month of the 'tuleu' type harvesting period was achieved.

A good diversity was created in the offspring in terms of weight and firmness of the fruit. All 4 cvs. have larger fruits than those of 'Tuleu gras' cv. with differences from 7.3 g (for 'Centenar' cv.) to 24.5 g (for 'Roman' cv.). The firmness, although higher at 'Tuleu gras' cv. (51.3 HPE), presents very good values even in the case of the 'Tita' cv. with the lowest fruit firmness (41.4 HPE).

The color of the fruit is a variable with small amplitude, not only in this case, but also in terms of consumer preferences regarding the fruits of the species *Prunus domestica*. However, we can notice that the 'Piteștean' cv. presents the fruits with the darkest color (with values of the chromatic indicator  $b^*$  of -4.95).

'Tuleu gras' cv. has the best sugar accumulation among all the studied cvs. (15.7% Brix), while 'Piteștean' is the cv. with the highest acidity (0.46 g / 100ml malic acid).

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#### Tables

**Table 1. Harvest time (number of days from 1 February)**

Cultivar	Average - days (2018-2020)*	Average - date
Piteștean	177 <sup>b</sup>	26 - 27 Jul.
Centenar	178 <sup>b</sup>	27 - 28 Jul.
Tita	180 <sup>b</sup>	30 Jul.- 1 Aug.
Roman	182 <sup>b</sup>	1 - 3 Aug.
Tuleu gras	210 <sup>a</sup>	28 - 29 Aug.

\*) values in columns that do not have common letters differ significantly for one level of assurance 5% statistic, Duncan test

**Table 2. Weight and firmness of the studied cultivars**

Cultivar	Weight (g)*				Firmness (HPE)*			
	2018	2019	2020	Average	2018	2019	2020	Average
Piteștean	39.6 <sup>c</sup>	47.2 <sup>c</sup>	33.1 <sup>d</sup>	39.9 <sup>b</sup>	49.3 <sup>b</sup>	39.2 <sup>b</sup>	45.7 <sup>a</sup>	44.7 <sup>ab</sup>
Centenar	39.9 <sup>c</sup>	35.4 <sup>d</sup>	41.4 <sup>c</sup>	38.9 <sup>b</sup>	45.5 <sup>b</sup>	45.7 <sup>a</sup>	62.0 <sup>a</sup>	51.1 <sup>a</sup>
Tita	42.3 <sup>b</sup>	55.2 <sup>b</sup>	69.2 <sup>a</sup>	55.5 <sup>a</sup>	27.8 <sup>c</sup>	47.5 <sup>a</sup>	49.0 <sup>b</sup>	41.4 <sup>b</sup>
Roman	46.8 <sup>a</sup>	60.1 <sup>a</sup>	61.4 <sup>b</sup>	56.1 <sup>a</sup>	44.2 <sup>b</sup>	36.0 <sup>b</sup>	57.4 <sup>a</sup>	45.9 <sup>ab</sup>
Tuleu gras	31.0 <sup>d</sup>	31.8 <sup>e</sup>	32.2 <sup>d</sup>	31.6 <sup>c</sup>	57.9 <sup>a</sup>	36.6 <sup>b</sup>	59.5 <sup>a</sup>	51.3 <sup>a</sup>

\*) values in columns that do not have common letters differ significantly for one level of assurance 5% statistic, Duncan test

**Table 3. The color of the five studied cultivars, in the Ciel Lab system**

Cultivar →		Piteștean*	Centenar*	Tita*	Roman*	Tuleu gras*
Year ↓						
2018	L*	24.68 <sup>a</sup>	21.84 <sup>ab</sup>	20.57 <sup>c</sup>	21.70 <sup>ab</sup>	22.46 <sup>b</sup>
	a*	1.32 <sup>b</sup>	4.13 <sup>b</sup>	3.03 <sup>b</sup>	5.03 <sup>b</sup>	17.98 <sup>a</sup>
	b*	1.32 <sup>b</sup>	1.15 <sup>a</sup>	0.49 <sup>ab</sup>	0.92 <sup>ab</sup>	-1.38 <sup>bc</sup>
2019	L*	30.74 <sup>a</sup>	31.86 <sup>a</sup>	29.40 <sup>a</sup>	24.35 <sup>b</sup>	25.11 <sup>b</sup>
	a*	1.83 <sup>b</sup>	2.01 <sup>b</sup>	3.48 <sup>b</sup>	2.00 <sup>b</sup>	5.16 <sup>a</sup>
	b*	-5.07 <sup>bc</sup>	-6.48 <sup>c</sup>	-3.91 <sup>b</sup>	-3.96 <sup>b</sup>	0.32 <sup>a</sup>
2020	L*	30.75 <sup>a</sup>	23.62 <sup>b</sup>	26.29 <sup>ab</sup>	27.61 <sup>ab</sup>	27.65 <sup>ab</sup>
	a*	1.56 <sup>a</sup>	4.94 <sup>a</sup>	10.75 <sup>a</sup>	4.71 <sup>a</sup>	6.12 <sup>a</sup>
	b*	-6.44 <sup>c</sup>	0.27 <sup>a</sup>	-3.44 <sup>abc</sup>	-4.61 <sup>bc</sup>	-1.95 <sup>ab</sup>
Average	L*	28.72 <sup>a</sup>	25.77 <sup>b</sup>	25.42 <sup>b</sup>	24.55 <sup>b</sup>	25.07 <sup>b</sup>
	a*	1.57 <sup>b</sup>	3.69 <sup>b</sup>	5.66 <sup>ab</sup>	3.91 <sup>b</sup>	9.75 <sup>a</sup>
	b*	-4.95 <sup>b</sup>	-1.68 <sup>a</sup>	-2.28 <sup>a</sup>	-2.55 <sup>a</sup>	-1.00 <sup>a</sup>

\*) values in columns that do not have common letters differ significantly for one level of assurance 5% statistic, Duncan test

**Table 4. Determinations regarding the main organoleptic components in the studied plum cultivars**

Cultivar →		Piteștean*	Centenar*	Tita*	Roman*	Tuleu gras*
Year ↓						
TSS (%)	2018	13.1 <sup>a</sup>	11.5 <sup>b</sup>	10.9 <sup>b</sup>	13.0 <sup>a</sup>	13.8 <sup>a</sup>
	2019	11.33 <sup>b</sup>	8.4 <sup>c</sup>	9.6 <sup>c</sup>	11.5 <sup>b</sup>	15.7 <sup>a</sup>
	2020	13.1 <sup>a</sup>	12.3 <sup>a</sup>	13.8 <sup>a</sup>	13.4 <sup>a</sup>	12.9 <sup>a</sup>
	<b>Average</b>	<b>12.4<sup>bc</sup></b>	<b>10.7<sup>d</sup></b>	<b>11.4<sup>cd</sup></b>	<b>12.6<sup>b</sup></b>	<b>14.1<sup>a</sup></b>
pH	2018	4.8 <sup>c</sup>	5.2 <sup>a</sup>	4.9 <sup>b</sup>	4.7 <sup>d</sup>	4.5 <sup>e</sup>
	2019	4.0 <sup>b</sup>	3.6 <sup>c</sup>	3.4 <sup>d</sup>	4.0 <sup>b</sup>	5.0 <sup>a</sup>
	2020	4.9 <sup>c</sup>	5.4 <sup>b</sup>	5.3 <sup>b</sup>	5.8 <sup>a</sup>	5.0 <sup>c</sup>
	<b>Average</b>	<b>4.5<sup>a</sup></b>	<b>4.7<sup>a</sup></b>	<b>4.5<sup>a</sup></b>	<b>4.8<sup>a</sup></b>	<b>4.8<sup>a</sup></b>
Malic acid (g/100 ml)	2018	0.28 <sup>c</sup>	0.17 <sup>e</sup>	0.27 <sup>d</sup>	0.29 <sup>b</sup>	0.42 <sup>a</sup>
	2019	0.26 <sup>c</sup>	0.26 <sup>c</sup>	0.34 <sup>b</sup>	0.43 <sup>a</sup>	0.24 <sup>d</sup>
	2020	0.86 <sup>a</sup>	0.55 <sup>c</sup>	0.49 <sup>d</sup>	0.39 <sup>e</sup>	0.68 <sup>b</sup>
	<b>Average</b>	<b>0.46<sup>a</sup></b>	<b>0.32<sup>b</sup></b>	<b>0.36<sup>ab</sup></b>	<b>0.37<sup>ab</sup></b>	<b>0.44<sup>ab</sup></b>

\*) values in columns that do not have common letters differ significantly for one level of assurance 5% statistic, Duncan test