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FLORAL BIOLOGY OF SOME AUTOCHTHONOUS SOUR CHERRY GENOTYPES FROM THE GERMPLASM FUND

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Abstract

Knowledge of flower biology has a significant importance, particularly in sour cherry which shows different degrees of incompatibility. The main objective of this paper is to study some aspects regarding floral biology of 42 autochthonous sour cherry genotypes: beginning, ending and intensity of flowering, self-fertility, as well as the viability and germination capacity of pollen. The phenological observations were made noting the date on 1-5% of flowers opened (beginning of flowering) and when 95-100% of flowers fell (end of flowering). The degree of self-fertility was determined by isolating 100 flowers and counting the fruits set. The pollen viability was determined in acetic carmine. The pollen germination capacity was determined in vitro on solid medium (15% sucrose, 1.5 g agars, 0.01 g boric acid in 100 ml distilled water), under laboratory conditions (temperature 18-20ºC and relative humidity of 70-90%). In 2024, the average date of beginning of flowering for the 42 sour cherry genotypes was April 6, varying from April 3 at 'Drobeta', 'Turcești', 'Mari timpurii', 'Mocănești 16', 'Timpurii de Pitești' cvs. and April 9 at the 'Bucovina', 'Crișana 2' and clones, 'Dropia', 'Ilva', 'Nana', 'Stelar', 'Vrâncean', 'Mărculești' and his clones. Average flowering duration was 9 days and average flowering intensity was medium to high (notes 3.5-4). The average value of pollen viability was 78.47%, varying from 91.85% at 'Selecție M' genotype and 37.89% at 'Mari timpurii cl. 11' genotype. The average value of pollen germination was 18.01%, varying from 38.55% at 'Rival' cv. and 4.87% at 'Topologu Tulcea' cv. Regarding self-fertility, the sour cherry genotypes studied were classified into 3 groups: self-fertile (e.g. 'Bucovina', 'Ilva', 'Nana', 'Rival', 'Suraia Vrancea' cvs. - over 10% fruits set); partially self-fertile (e.g. 'Mocănești 16', 'Scuturător', 'Stelar', 'Timpurii de Osoi', 'Brezniţa' cvs. - 5-10% fruits set) and self-sterile (e.g. 'Dropia', 'Ţarina', 'Vrâncean', 'Crișana 2', 'Locale de Bistriţa' cvs. – below 5% fruits set). The results regarding floral biology in sour cherry provide information regarding the use of a variety as a pollinator in commercial orchards, as well as a parent in breeding works.

Key words*: phenology, pollen viability, pollen germination, self-fertility, sour cherry.*

INTRODUCTION

Sour cherry (*Prunus cerasus* L.) is an important fruit species in worldwide, and Romania is among the top ten producing countries. The area cultivated with sour cherry in Romania was 2,760 ha, which ensured a production of 29,000 tones (at the level of the year 2023) (FAOSTAT, 2025).

Sour cherry belongs to the group medium to early blooming species, but is the latest among stone fruits (Nyéki et al., 2002; Fotirić Akšić et al., 2013).

It is known that flowering is the most important process in the development of fruit trees, fruit production and their quality depending on the flowering course conditions and especially on the pollination and fecundation of flowers (Lech, 1990; Szpadzik et al., 2010).

Realization of the pollination process in good conditions positively influences the fruits setting.

Pollination and fecundation of flowers at a high level depends on the pollen quality, the degree of self-fertility of the varieties, the climatic conditions during the flowering, but also on the presence of bees in the sour cherry orchards during the flowering period.

Some authors believe that the viability and germination of pollen are positively correlated with fruit setting (Wocior, 1975; Milutinovic et al., 1997; Szpadzik et al., 2008, 2010).

The authors note that pollen germination is even more important, depending on the pollen viability and the climatic conditions during the flowering. Sometimes the viable pollen grains have not a good germination.

From the point of view of the behavior in the pollination and fecundation process the sour cherry varieties are grouped into 3 classes: self-fertile, partially self-fertile and self-sterile (Cimpoieş, 2002).
Lech (1984) believes that when it sets 30% of fruits after pollination the yield is satisfying. Nyeki et al. (1997) think that even if 20% of flowers set fruits, the production is economical. Budan and Gradinariu (2000), Butac (2004) consider that when the percentage of fruit set is between 10 and 15% a normal fruit harvest is obtained.
Most scientists consider that the cultivars which have a high degree of self-fertility give a good yield. Also, self-fertile cultivars give a good production regardless of the evolution of the climatic conditions (low temperature or rain) (Wocior, 1977; Szpadzik et al., 2008; 2010).
The main objective of this paper is to study some aspects regarding floral biology of 42 autochthonous sour cherry genotypes from national germplasm fund: beginning, ending and intensity of flowering, self-fertility, as well as the viability and germination capacity of pollen.

MATERIALS AND METHODS

Field trial and plant material

The research was carried out in sour cherry germplasm collection from Genetic and Breeding Department of Research Institute for Fruit Growing located in Mărăcineni - Argeş area.
The sour cherry collection was planted in 2010 and comprises 144 genotypes of which 54 Romanian and 90 of foreign origin.
Of these, 42 bred and local Romanian genotypes were evaluated from the point of view of the flowering phenophases, degree of self-fertility, viability and germination capacity of pollen.

Measurements

The observations regarding blooming time were carried out, as follows (Nyeki et al., 2014):
- Beginning of flowering – noting the date when 1-5% of flowers are opened;
- Ending of flowering - noting the date when 95-100% of flowers fell;
- Duration of flowering - was calculated the number of days from the beginning until the end of flowering;
- Intensity of flowering -was appreciated by notes from 1 (very low intensity) to 5 (very high intensity.
The viability of pollen was determined by the method of coloring with acetic carmine by which the fertile pollen is colored in red, and the sterile pollen remains colorless (Cociu and Oprea, 1989; Botu and Botu, 1997).
The germination capacity of pollen was determined *in vitro* on solid medium (15% sucrose, 1.5 g agars, 0.01 g boric acid in 100 ml distilled water), under laboratory conditions (temperature 18-20ºC and relative humidity of 70-90%).
The reading of the preparations was performed at the MC-5 electron microscope, with the objective x40.
The degree of self-fertility was determined by isolating 100 flowers and counting the fruits set.

Statistical analysis

The data were included in an Excel database and statistically interpreted with some statistic indices: average, standard deviations and variability coefficient (%).

RESULTS AND DISCUSSIONS

Blooming time

The observations regarding flowering phenophases was carried out in 2024 year which was the hottest in the last 54 years, with 2.6ºC over normal (12.7ºC compared to 10.1ºC as normal), but also much poorer in precipitation, with 146.2 mm below normal (527.0 mm compared to 673.2 mm as it represents the normal period 1969-2023). Also, the average temperatures of the first four months of the year were much higher than the normal area (with 0.8ºC in January, with 5.8ºC in February, with 2.9ºC in March and with 3.0ºC in April).
All these high temperatures have had the effect of earlier flowering than the normal flowering time in Mărăcineni - Argeş area for sour cherry, respectively April 18 for beginning of flowering and April 28 for ending of flowering.

It is observed that in 2024 the average date regarding the beginning of flowering for all autochthonous genotypes studied was April 6, being with 12 days earlier than the average flowering date in the Mărăcineni - Argeş area (Tables 1 and 2).

The average date of the end of flowering for all Romanian genotypes was April 15, being with 13 days earlier than the normal average date of this phenophase (Tables 1 and 2).

From the point of view of the blooming time, they were noted for the late flowering: 'Bucovina', 'Crişana 2', 'Dropia', 'Ilva', 'Nana', 'Stelar', 'Vrâncean' – bred cultivars; 'Crişana Cluj', 'Crişana Nazarcea', 'Crişana 4/6', 'Mărculeşti 1/7', 'Mărculeşti 15/2', 'Mărculeşti 32/20', 'Mărculeşti P2 Vie', 'Băneasa 6/26', 'Tg. Jiu 200', 'Selecţie Vrancea', 'Topoloveni' and 'Selecţie M' – local genotypes.

The same period of flowering and earliness of blooming was also reported in Serbia for 'Oblačinska' cv., in Hungary for 'Ujfehértói fürtös' cv., as well as in Poland for some cultivars such as 'Schattenmorelle', 'Debreceni Botermo' and 'Ujfehértói fürtös' cvs. (Szpadzik et al., 2010; Mika et al., 2011; Fotirić Akšić et al., 2013; Nyéki et al., 2014).

Table 1. Flowering phenophases of sour cherry bred cultivars from genetic resources fund - 2024, RIFG Piteşti, Romania

Cultivars	Beginning (day/month)	Ending (day/month)	Duration (days)	Intensity (note)
Bucovina	9.04	17.04	8	4
Crişana 2	9.04	17.04	8	4
De Botoşani	4.04	13.04	9	4
Dropia	9.04	16.04	7	4
Ilva	9.04	18.04	9	4
Mocăneşti 16	3.04	15.04	12	4
Nana	9.04	18.04	9	4
Rival	4.04	12.04	8	4
Scuturător	4.04	13.04	9	4
Stelar	9.04	19.04	10	4
Timpurii de Osoi	3.04	12.04	9	4
Timpurii de Piteşti	3.04	12.04	9	4
Ţarina	4.04	13.04	9	4
Vrâncean	9.04	18.04	9	4
Average	**6.04**	**15.04**	**9**	**4**

The average flowering duration was short, only 9 days due to the very high temperatures from blooming time. However, there were some genotypes where the flowering period was a little longer, 10-13 days: 'Bizigheşti', 'Mocăneşti 16', 'Stelar', 'Mărculeşti P2 Vie', 'Mărculeşti P4 Vie', 'Suraia Vrancea', 'Focşani 3' (Tables 1 and 2).

In 2024 the intensity of flowering was high (note 4), being higher at bred cultivars than at local ones (Tables 1 and 2). All the bred cultivars had a high intensity of the flowering (note 4), while in the case of the local genotypes, 12 of them had a medium flowering intensity (note 3).

Table 2. Flowering phenophases of sour cherry genotypes (local cultivars and selections) from genetic resources fund - 2024, RIFG Piteşti, Romania

Cultivars	Beginning (day/month)	Ending (day/ month)	Duration (days)	Intensity (note)
Crişana Cluj	9.04	18.04	9	4
Crişana Nazarcea	9.04	18.04	9	3
Crişana 4/6	9.04	17.04	8	3
Mărculeşti 1/7	9.04	17.04	8	3
Mărculeşti 15/2	9.04	18.04	9	3
Mărculeşti 32/20	9.04	18.04	9	3
Mărculeşti 33/13	4.04	12.04	8	3
Mărculeşti P2 Vie	9.04	20.04	11	4
Mărculeşti P4 Vie	4.04	17.04	13	3
Drobeta	3.04	12.04	9	3
Băneasa 4/7	9.04	18.04	9	3
Băneasa 6/26	9.04	18.04	9	3
Breznița	4.04	11.04	7	3
Bizigheşti	4.04	16.04	12	4
Mari timpurii	3.04	11.04	8	4
Mari timpurii cl. 11	4.04	12.04	8	3
Tg. Jiu 200	9.04	17.04	8	4
Tg. Jiu 505	3.04	14.04	11	4
Tg. Jiu 404	4.04	12.04	8	4
Focşani 3	4.04	14.04	10	4
Locale de Bistrița	3.04	11.04	8	4
Suraia Vrancea	3.04	15.04	12	4
Selecţie Vrancea	9.04	17.04	8	4
Turceşti	3.04	12.04	9	4
Topologu Tulcea	4.04	12.04	8	4
Topoloveni	9.04	17.04	8	4
Selecţie Leordeni	3.04	12.04	9	4
Selecţie M	9.04	14.04	5	4
Average	**6.04**	**15.04**	**9**	**3.5**

Quality of pollen (viability and germination capacity)

Research regarding the viability and germination capacity of pollen, in addition to the practical importance related to the quantity and quality of the yield to obtain under optimal pollination conditions, also have a theoretical valence correlated with their potential use as

genitors in the breeding works (Zoican and Maresi, 2022).

According to Davarynejad et al. (2008) high percentage of pollen viability and germination capacity are important to decide the best pollinator. Also, it is known that not all pollen grains germinated on stigma can reach to the ovule.

On bred cultivars, the average value of pollen viability was 78.24% ranging from 91.27 at 'Bucovina' cv. and 54.62 at 'Vrâncean' cv. (Table 3).

Table 3. Pollen viability and germination capacity of sour cherry bred cultivars from genetic resources fund - 2024, RIFG Piteşti, Romania

Cultivars	Pollen viability (%)	Pollen germination (%)	Self-fertility (% fruit set)
Bucovina	91.27	12.97	15.62
Crişana 2	71.32	15.26	3.51
De Botoşani	81.73	19.25	3.69
Dropia	75.55	19.92	2.36
Ilva	82.95	11.34	16.48
Mocăneşti 16	79.06	10.87	8.94
Nana	76.21	29.10	11.34
Rival	86.78	38.55	10.25
Scuturător	83.96	23.52	5.38
Stelar	71.66	17.11	9.49
Timpurii de Osoi	86.49	13.60	5.81
Timpurii de Piteşti	89.78	20.94	6.47
Ţarina	63.95	16.25	3.74
Vrâncean	54.62	9.44	3.63
Average	**78.24**	**18.44**	**7.62**
Standard deviation	**10.29**	**7.90**	**4.55**
Coefficient of variability (%)	**13.15**	**42.86**	**59.69**

The results regarding the pollen viability are in accordance with the results reported by Zoican and Maresi in 2022 for 'Ţarina' cv.

On local genotypes, the average value of pollen viability was 78.70%. The highest viability was obtained from 'Selecţie M', while the lowest was from 'Mari timpurii cl. 11' (Table 4).

The coefficient of variability was 13.15% for bred cultivars and 17.87% for local genotypes, which indicates medium variability for this trait.

The pollen germination was 18.44% for bred cultivars and 17.58% for local genotypes.

The highest germination was obtained from 'Nana', 'Scuturător', 'Timpurii de Piteşti' (bred cultivars) and 'Crişana 4/6', 'Mărculeşti 15/2', 'Mărculeşti P2 Vie', 'Drobeta', 'Băneasa 6/26', 'Breznița', 'Bizigheşti', 'Tg. Jiu 505', 'Turceşti', 'Vişin Leordeni', 'Selecţie M' (local genotypes) (over 20%) (Tables 3 and 4).

Table 4. Pollen viability and germination capacity of local cultivars and selections from genetic resources fund - 2024, RIFG Piteşti, Romania

Cultivars	Pollen viability (%)	Pollen germination (%)	Self-fertility (% fruit set)
Crişana Cluj	44.44	13.46	8.49
Crişana Nazarcea	70.21	16.66	9.44
Crişana 4/6	83.70	23.70	3.51
Mărculeşti 1/7	82.09	6.22	1.41
Mărculeşti 15/2	87.70	28.98	2.35
Mărculeşti 32/20	80.08	19.90	4.78
Mărculeşti 33/13	65.64	11.38	6.53
Mărculeşti P2 Vie	87.16	20.77	4.23
Mărculeşti P4 Vie	63.65	15.34	5.46
Drobeta	91.36	31.59	10.58
Băneasa 4/7	77.83	7.40	1.25
Băneasa 6/26	91.18	30.09	8.45
Breznița	84.61	22.34	8.76
Bizigheşti	88.33	21.40	11.26
Mari timpurii	53.70	9.04	3.28
Mari timpurii cl. 11	37.89	6.07	2.89
Tg. Jiu 200	74.02	14.61	5.18
Tg. Jiu 505	81.71	26.70	11.64
Tg. Jiu 404	86.48	14.19	6.57
Focşani 3	78.43	10.74	3.25
Locale de Bistriţa	90.27	8.04	3.56
Suraia Vrancea	87.37	19.52	15.97
Selecţie Vrancea	78.07	16.04	6.72
Turceşti	87.33	23.00	10.86
Topologu Tulcea	88.88	4.87	1.15
Topoloveni	80.23	12.40	7.51
Vişin Leordeni	89.50	27.23	10.36
Selecţie M	91.85	30.58	8.45
Average	**78.70**	**17.58**	**6.57**
Standard deviation	**14.06**	**8.16**	**3.74**
Coefficient of variability (%)	**17.87**	**46.44**	**56.93**

There is no correlation between the viability of pollen and its germination capacity. For example, on 'Ţarina' cv. the viability of the pollen is low (63.95%), but the germination is good (16.25%). On 'Topologu Tulcea' variety, the viability of the pollen is high (88.88%), but the germination is very low (4.87%). On 'Rival' cv., both the viability and the germination of the pollen have high values (86.78%, respectively 38.55%). On 'Turceşti' variety the germination capacity of the pollen was good (23%), but the pollen tubes were very short, being the possibility that they do not reach the ovule (Figure 1).

The values of the coefficient of variability for this character are very high (over 40%) which indicates an extremely high variability and the possibility to selecting potential genitors for breeding works.

Tosun and Koyuncu (2007) studied sour cherry pollens quality and reported that pollen viability rate reached 80-93% and pollen germination rate was 57-67%.

Our results were similar to those reported by Tosun and Koyuncu (2007) for pollen viability, but much smaller regarding pollen germination.

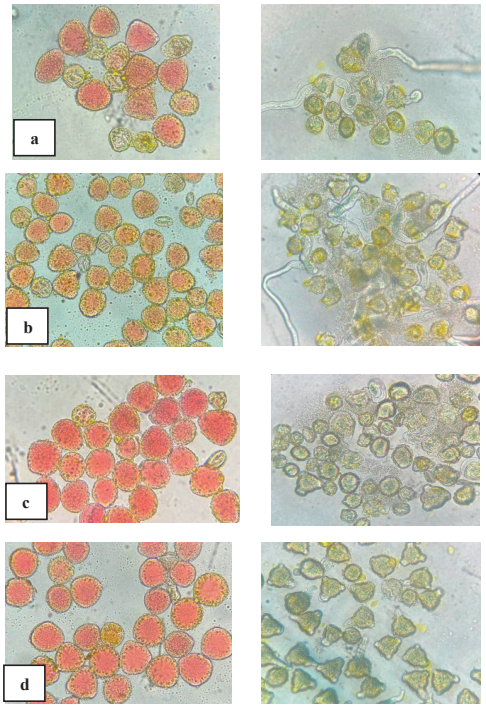

Figure 1. Pollen viability and germination capacity on some genotypes studied: a - 'Ţarina'; b - 'Rival'; c - 'Topologu Tulcea'; d - 'Turceşti'

Self-fertility

The percentage of fruits set after self-pollination was 7.62% for bred cultivars and 6.57% for local genotypes (Tables 3 and 4). According to data reported by Szabo (2007) and Davarynejad (2008), a percentage of fruits set to over 5% can be considered acceptable. After the percentage of fruits set after self-pollination, Nyeki et al. (2000) classified the sour cherry cultivars in three groups: adequate (above 10%), acceptable (5-10%) and weak (below 5%).

In our study 23.80% of the studied genotypes had a percentage of fruits set over 10% (Tables 3 and 4).

According to Nyeki's classification, the genotypes studied were grouped as follows:

- adequate – self fertile (over 10% fruits set) – 10 genotypes: 'Bucovina', 'Ilva', 'Nana', 'Rival', 'Drobeta', 'Bizigheşti', 'Tg. Jiu 505', 'Suraia Vrancea', 'Turceşti', 'Vişin Leordeni';
- acceptable – partially self fertile (5-10% fruits set) – 16 genotypes: 'Mocăneşti 16', 'Scuturător', 'Stelar', 'Timpurii de Osoi', 'Timpurii de Piteşti', 'Crişana Cluj', 'Crişana Nazarcea', 'Breznița', 'Topoloveni', etc.;
- weak – self sterile (below 5% fruits set) – 16 genotypes: 'Crişana 2', 'De Botoşani', 'Dropia', 'Ţarina', 'Vrâncean', 'Mari timpurii', 'Locale de Bistriţa', 'Topologu Tulcea', etc.

It can be observed that, compared to the 'Crişana 2' cv. (with a small degree of self - fertility), two clones ('Crişana Cluj' and 'Crişana Nazarcea') have a higher degree of self -fertility.

It can also be seen that there is no always a correlation between the pollen germination capacity and the degree of self-fertility. For example, there are genotypes that have acceptable the pollen germination and the percentage of fruits set after self pollination ('Bucovina', 'Ilva', 'Nana', 'Rival', 'Stelar', 'Crişana Cluj', 'Crişana Nazarcea', 'Drobeta', 'Bizigheşti', 'Tg. Jiu 505', 'Suraia Vrancea', 'Turceşti'), but there are genotypes that have a large percentage of pollen germination but a small percentage of fruits set ('Crişana 2', 'De Botoşani', 'Dropia', 'Timpurii de Piteşti', 'Ţarina', 'Vrâncean', 'Crişana 4/6', 'Băneasa 6/26', etc.) (Tables 3 and 4).

The values of the coefficient of variability for this character are very high (56.93%) which indicates an extremely high variability.

CONCLUSIONS

The results regarding floral biology in sour cherry provide information regarding the use of a variety as a pollinator in commercial orchards, as well as a parent in breeding works.

Regarding the flowering period, it can be said that in 2024 due to the very high temperatures from the beginning of the year, the genotypes studied have blossomed 12 days earlier than the normal flowering period of the Mărăcineni - Argeş area, thus being exposed to the late spring frosts. However, in the germplasm fund there are also genotypes with late flowering that can be used as gene sources for this trait.

The tests regarding the pollen viability and germination have highlighted the fact that in the collection of genetic resources exit genotypes with high germination and therefore

with the possibility of being used as pollinators in commercial orchards but also as genitors in breeding works (e.g. 'Nana', 'Scuturător', 'Timpurii de Piteşti', 'Drobeta', 'Bizigheşti', 'Brezniţa', 'Turceşti', etc.).

Regarding self-fertility, the sour cherry genotypes studied were classified into 3 groups: self-fertile (e.g. 'Bucovina', 'Ilva', 'Nana', 'Rival', 'Suraia Vrancea' cvs. – over 10% fruits set); partially self-fertile (e.g. 'Mocănești 16', 'Scuturător', 'Stelar', 'Timpurii de Osoi', 'Brezniţa' cvs. - 5-10% fruits set) and self-sterile (e.g. 'Dropia', 'Ţarina', 'Vrâncean', 'Crişana 2', 'Locale de Bistriţa' cvs. – below 5% fruits set).

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