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STUDY ON INFLUENCE OF CLIMATE CONDITIONS ON SOME BLACK ELDERBERRY SELECTIONS' CHARACTERS

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Abstract
Sambucus nigra L. is part of the Adoxaceae family and is a shrub that prefers sunny places and is a native plant to Europe, America, Northern Africa and Western and Central Asia. The Sambucus nigra L. flowers and fruits have a long history of use in traditional European medicine, are used as treatment of diabetes and viral infections, fever, colds and flu. From elderberry fruits and flowers, tea, syrup and different alcoholic beverages can be obtained.
Black elderberry (Sambucus nigra L.) is a species that is also spread in Romania and its flowers and fruits are used for different purposes. The black elderberry produces umbels of cream-white flowers in early summer and blue-black fruits with a diameter of up to 6 mm, which ripen in late summer. The aim of this paper is to analyze the prevalence of climatic conditions on elderberry flower yields of different selections from spontaneous flora in two locations from the Oltenia region. Biometric data of quantitative traits have been collected from 10 elderberry selections in 2017 and 2018.

Keywords: Sambucus nigra L., climatic data, biometric data.

1. INTRODUCTION

Sambucus nigra L. is part of the *Adoxaceae* family, being a shrub that prefers sunny places (Applequist, 2015). It is a plant native to Europe, America, Northern Africa and Western- and Central Asia (Christensen et al., 2007). They produce umbels of cream-white flowers in early summer and blue-black fruits with a diameter up to 6 mm which ripen in late summer (Charlebois et al., 2010).

Sambucus nigra L. can be used as an ornamental plant (Christensen et al., 2007) and its flowers and fruits can be used as a material for the production of food and beverages (Dawidowicz et al., 2006; Simonovik et al., 2007). Lately, the cultivation of this plant has received increased attention due to its high content of anthocyanins (Akbulut et al., 2009), which are used as food colorants primarily in the beverage industry (He and Giusti, 2010).

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Some parts of *Sambucus nigra* L. plant, particularly stems and immature fruits, can be toxic due to a variety of toxic alkaloids and cyanogenic glycosides (Lewis and Elvin-Lewis, 2003). According to Valles et al., 2004, *Sambucus nigra* L. is one of the most versatile plants because it can be used in many ways. According to the same authors its health promoting properties are known from ancient times and nowadays numerous studies confirm it. Numerous researchers (Zakay-Rones et al., 1995; Barak et al., 2002; Roschek et al., 2009) reported that *Sambucus nigra* L. has numerous health benefits such as anti-inflammatory, antibacterial and antiviral properties. The *Sambucus nigra* L. flowers and fruits have a long history of use in traditional European medicine, being used as treatment of diabetes and viral infections, fever, colds and flu (Botu and Botu, 2000; Vuković et al., 2016).

Black elderberry (*Sambucus nigra* L.) is a shrub species which is spread also in Romania and its flowers and fruits being used for different purposes (Botu and Botu, 2000). From elderberry flowers tea, syrup and different alcoholic beverages can be obtained. The aim of this paper is to analyze the influence of climatic conditions on elderberry flower yields on different selections from spontaneous flora in two locations from Oltenia region. Biometric data of main quantitative traits has been collected from 10 elderberry selections in 2017 and 2018.

2. MATERIALS AND METHODS

For this study the black elderberry population from some areas from Oltenia region were analyzed over 2016-2018 period. During the study, a number of 10 genotypes of black elderberry were selected, the biological material being taken from the spontaneous flora in the areas of Craiova and Râmnicu Vâlcea. Selection was based on their productive characteristics, observations, measurements and determinations were performed on these genotypes both in situ and in the laboratory.

The inflorescences collected from these genotypes were analyzed during the study years (2016-2018). For each inflorescence it was determined the diameter on two directions, the thickness of the rachis and the average weight of an inflorescence.

On the basis of the average values obtained, a series of statistical indices were calculated using the MS Excel program.

Several climatic factors that can influence the growth and development of black elderberry were analyzed. Climatic data was monitored throughout the study, namely:

1. Air temperature (°C) at altitude of 2 meters above ground;
2. Atmospheric pressure (mm);
3. Relative humidity (%) at an altitude of 2 meters above the ground;
4. Rainfall (mm).

3. RESULTS AND DISCUSSIONS

From the climatic point of view are little differences between the mean annual, minimum and maximum temperatures in both locations during the study period.

In Table 1 is presented the air temperature during the study period for two sites (Craiova and Râmnicu Vâlcea weather stations). The minimum value that was recorded during the study period was -17.1°C in Craiova, while in Râmnicu Vâlcea was -19.1°C on January 10th, 2017. The maximum value recorded in Râmnicu Vâlcea was 38.6°C on August 5th, 2017 and in Craiova 39.6°C on August 4th, 2017.

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Table 1. Air temperature (°C) measured at 2 m above ground (°C) in the two locations
(Sources: https://rp5.ru/Arhiva_meteo_în_Râmnicu_Vâlcea;
http://rp5.co.uk/Arhiva_meteo_în_Craiova_(aeroport))

Locations	**Period analyzed**	**Mean annual temperature**	**Minimum**	**Maximum**
			temperature recorded during study period (date)	
Craiova	01.01.2017 - 31.12.2018, all days	+12.5°C	-17.1°C (10.01.2017)	+39.6°C (04.08.2017)
Râmnicu Vâlcea	01.01.2017 - 31.12.2018, all days	+ 12.2°C	-19.1°C (10.01.2017)	+38.6°C (05.08.2017)

In Table 2 the atmospheric pressure is presented in the two weather stations during the study. The mean value of atmospheric pressure in Râmnicu Vâlcea was 741.5 mmHg, while the minimum value of 721.7 mmHg was recorded on January 17th, 2018 and the maximum value of 757.7 mmHg on February 12th, 2017. In Craiova, the mean value was 745.4 mmHg, respectively the minimum value of 725.6 mmHg in January 17th, 2018 and the maximum of 761.6 mmHg on February 12th, 2017.

Table 2. The atmospheric pressure (millimeter mercury column) recorded in the two locations
(Sources: https://rp5.ru/Arhiva_meteo_în_Râmnicu_Vâlcea;
http://rp5.co.uk/Arhiva_meteo_în_Craiova_(aeroport))

Locations	**Period analyzed**	**Mean value of atmospheric pressure**	**Minimum value** (date)	**Maximum value** (date)
Craiova	01.01.2017 - 31.12.2018, all days	745.4 mmHg	725.6 mmHg (17.01.2018)	761.6 mmHg (12.02.2017)
Râmnicu Vâlcea	01.01.2017 - 31.12.2018, all days	741.5 mmHg	721.7 mmHg (17.01.2018)	757.7 mmHg (12.02.2017)

Relative humidity (Table 3), which was recorded at 2 meters above the ground, has an average value of 72% in Craiova and 74% in Râmnicu Vâlcea. The minimum value of 13% was recorded on 04.08.2017 in Craiova and 11% on 02.04.2017 in Râmnicu Vâlcea.

Table 3. Relative humidity (%) recorded 2 m above ground
(Sources: https://rp5.ru/Arhiva_meteo_în_Râmnicu_Vâlcea;
http://rp5.co.uk/Arhiva_meteo_în_Craiova_(aeroport))

Locations	**Analyzed period**	**Mean value**	**Minimum value** (date)
Craiova	01.01.2017 - 31.12.2018, all days	72%	13% (08.04.2017)
Râmnicu Vâlcea	01.01.2017 - 31.12.2018, all days	74%	11% (02.04.2017)

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In Table 4 the amount of rainfall during the two years of study is presented. The sum of precipitation reached 1273 mm in Craiova and 2345 mm in Râmnicu Vâlcea. The amount of rainfall in Râmnicu Vâlcea is almost double during the entire time of study of two years.

Table 4. Amount of precipitation (mm)
(Sources: https://rp5.ru/Arhiva_meteo_în_Râmnicu_Vâlcea;
http://rp5.co.uk/Arhiva_meteo_în_Craiova_(aeroport))

Locations	Period analyzed	Sum of precipitation	Maximum value (date)	No. of days with rainfall
Craiova	01.01.2017 - 31.12.2018, all days	1273 mm	70.0 mm in 12 hours (27.07.2018)	319
Râmnicu Vâlcea	01.01.2017 - 31.12.2018, all days	2345 mm	43.0 mm in 12 hours (7.10.2018)	304

The maximum amount of rainfall in 12 hours was 70 mm recorded on 27.07.2018 in Craiova and 43 mm on 10.07.2018 in Râmnicu Vâlcea. The number of days with precipitation was 319 in Craiova and 304 in Râmnicu Vâlcea, although the total amount of rainfall was more important in the second location.

In case of all the black elderberry genotypes the following characteristics of inflorescences were measured in 2017 and 2018: large and small diameters, thickness of the rachis and total weight of the inflorescences. Mean, variance, standard deviation and coefficient of variation were determined for each selection during the study period.

Data collected in 2017 are presented in table 5 and data collected in 2018 are presented in table 6.

Table 5. Mean biometric data of the inflorescences of black elderberry (Sambucus nigra L.) in 2017

No.	Selections	Large diameter (cm)	Small diameter (cm)	Thickness of rachis (mm)	Total inflorescence weight (g)
1	Craiova 69	14.9	11.4	3.4	2.56
2	Craiova 63	13.0	9.4	3.0	2.08
3	Craiova 111	7.4	5.3	2.8	1.74
4	Craiova 88	10.4	7.8	2.7	2.03
5	Craiova 29	13.5	11.2	2.7	2.19
6	Craiova 79	14.6	11.6	3.4	2.31
7	Râmnicu Vâlcea 33	10.8	8.0	3.2	2.06
8	Râmnicu Vâlcea 147	13.6	11.8	4.1	2.25
9	Râmnicu Vâlcea 91	10.6	6.1	2.6	2.06
10	Râmnicu Vâlcea 29	9.7	7.3	3.6	2.13
Mean		***11.85***	***8.99***	***3.05***	***2.14***
Variance		***5.91***	***5.87***	***0.32***	***0.05***
Standard deviation		***2.43***	***2.42***	***0.57***	***0.21***
Coefficient of variation		***20.51***	***26.94***	***18.56***	***9.95***

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Variability can be observed in case of these characteristics, this can be explained due to the fact that each selection is a different genotype, but also due to the different climatic and soil conditions.
The large diameter of inflorescences varied from 7.4 mm ('Craiova 111' selection) to 14.9 ('Craiova 69' selection) and from 9.7 mm ('Râmnicu Vâlcea 29' selection) to 13.6 mm ('Râmnicu Vâlcea 147' selection) in 2017. The small diameter of inflorescences oscillated from 5.3 mm ('Craiova 111' selection) and 11.6 mm ('Craiova 69' selection) and 6.1 mm ('Râmnicu Vâlcea 91' selection) and 11.8 mm ('Râmnicu Vâlcea 147' selection). There were no major differences between rachis thickness, which varied from 2.6 mm ('Râmnicu Vâlcea 91' selection) to 4.1 mm ('Râmnicu Vâlcea 147' selection). Also, the weight of inflorescences oscillated in 2017 from 1.74 g ('Craiova 111' selection) to 2.56 g ('Craiova 69' selection).

Table 6. Mean biometric data of the inflorescences of black elderberry (Sambucus nigra L.) in 2018

No.	Selections	Large diameter (cm)	Small diameter (cm)	Thickness of rachis (mm)	Total inflorescence weight (g)
1	Craiova 69	17.3	11.7	5.3	2.60
2	Craiova 63	13.3	10.4	3.7	2.30
3	Craiova 111	9.4	5.0	2.8	1.79
4	Craiova 88	11.2	7.6	3.2	2.34
5	Craiova 29	14.0	10.8	3.6	2.21
6	Craiova 79	15.2	11.3	3.7	2.43
7	Râmnicu Vâlcea 33	11.2	8.3	2.1	2.11
8	Râmnicu Vâlcea 147	14.6	11.0	3.6	2.44
9	Râmnicu Vâlcea 91	11.6	7.5	2.9	2.18
10	Râmnicu Vâlcea 29	11.2	7.3	3.4	2.10
Mean		***12.86***	***9.06***	***3.54***	***2.25***
Variance		***5.89***	***5.09***	***0.48***	***0.05***
Standard deviation		***2.43***	***2.26***	***0.70***	***0.23***
Coefficient of variation		***18.87***	***24.91***	***19.67***	***10.27***

In 2018, the large diameter of inflorescences varied from 9.4 mm ('Craiova 111' selection) to 17.3 mm ('Craiova 69' selection) and from 11.2 mm ('Râmnicu Vâlcea 29' and 'Râmnicu Vâlcea 33' selections) to 14.6 mm ('Râmnicu Vâlcea 147' selection). In the same year, the small diameter of inflorescences had values from 5 mm ('Craiova 111' selection) to 11.7 mm ('Craiova 69' selection) and from 7.3 mm ('Râmnicu Vâlcea 29' selection) to 11 mm ('Râmnicu Vâlcea 147' selection).
In 2018, the rachis thickness varied from 2.1 mm ('Râmnicu Vâlcea 33' selection) to 5.3 mm ('Craiova 69' selection). The weight of inflorescences oscillated in 2018 from 1.79 g ('Craiova 111' selection) to 2.6 g ('Craiova 69' selection).
Based on the average data recorded in 2017 and 2018, we could establish correlations between the specified characters (tables 7, 8 and 9). As it can be seen in table 7, in 2017, two of the characters analyzed had no significant correlation (thickness of rachis versus large diameter of inflorescence). This can be explained due to the particularly climatic conditions from the year 2017. The second year, 2018, same characters show distinct significance (**). Taking into account the average data for both years, all characters showed significant correlations (table 9).

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Table 7. Correlations - black elderberry inflorescences (2017)

	Large diameter of inflorescence (cm)	Small diameter of inflorescence (cm)	Thickness of rachis (mm)	Total inflorescence weight (g)
Large diameter of inflorescence (cm)	1			
Small diameter of inflorescence (cm)	0.944 **	1		
Thickness of rachis (mm)	0.874 ns.	0.524 *	1	
Total inflorescence weight (g)	0.842 *	0.815 **	0.502 *	1

Table 8. Correlations - black elderberry inflorescences (2018)

	Large diameter of inflorescence (cm)	Small diameter of inflorescence (cm)	Thickness of rachis (mm)	Total inflorescence weight (g)
Large diameter of inflorescence (cm)	1			
Small diameter of inflorescence (cm)	0.942 **	1		
Thickness of rachis (mm)	0,874 **	0,746 **	1	
Total inflorescence weight (g)	0,884 **	0.855 **	0,763 **	1

Table 9. Correlations - black elderberry inflorescences (2017-2018 average)

	Large diameter of inflorescence (cm)	Small diameter of inflorescence (cm)	Thickness of rachis (mm)	Total inflorescence weight (g)
Large diameter of inflorescence (cm)	1			
Small diameter of inflorescence (cm)	0,966 **	1		
Thickness of rachis (mm)	0,791 **	0.737 **	1	
Total inflorescence weight (g)	0,931 **	0,865 **	0,826 **	1

The results obtained during study period have to be completed with more data which will be published in another paper.

4. CONCLUSIONS

The black elderberry genotypes that were studied in Craiova and Râmnicu Vâlcea during 2017-2018, under almost same mean temperature conditions, atmospheric pressure and air humidity, although the amount of rainfall was almost double in the second location, did not differ significantly from the point of view of biometrical data of inflorescences. Further studies on longer term and using same genotypes in both locations along with same growing conditions are necessary in order to study the influence of climate on black elderberry selections.

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