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MORPHOLOGICAL VARIABILITY OF SOME ROSEHIP FRUITS (*ROSA CANINA* L.) FROM THE SPONTANEOUS FLORA OF OLT COUNTY, ROMANIA

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Abstract

The present work aimed to analyse the variability of some genotypes of Rosa canina L. from some forest ecosystems located in the southern area of Olt County. Nine rosehip genotypes were subjected to the study, in which the morphological variability of the fruit was analysed starting from the dimensional and weight characteristics. It was found that there is a high variability between genotypes, highlighted by the Coefficient of Variability for weight (CV% = 32.86), height (CV% = 12.61), small fruit diameter (CV% = 12.47), and large fruit diameter (CV% = 12.33). The high existing variability is an essential factor through the presence of these genotypes and their usefulness as a sustainable resource in diversifying the fruit tree material.

Key words*: rosehip, fruits, genotypes, variability, coefficient of variation.*

INTRODUCTION

Wild edible fruit species, including those of the genus *Rosa*, are found naturally in many parts of the world, especially in rural areas and forests, and exhibit great morphological and biochemical diversity (Eyduran et al., 2022; Stoenescu et al., 2022). *Rosa* genus is one of the most diverse vegetable genera, fruit plants of this genus have been used for centuries (Bozhuyuk et al., 2021). Rosehip (*Rosa canina* L.) is a thorny shrub, pentaploid (2n=35), and xeromesophyte, reaching heights between 3 and 5 m (Ghiorghiță et al., 2012a, 2012b, 2012c). Taxonomically it is included in *Rosales* order, *Rosaceae* family, *Rosoidae* subfamily, and *Rosa* L. genus comprising 100-250 species (Šindrak et al., 2012; Stoenescu & Cosmulescu, 2021). The species is native to Europe, North-East Africa, and Western Asia and can be found from 0 to 1200 m altitude (Ghiorghiță et al., 2012a, 2012b; Tomljenović et al., 2022). Rosehip has great diversity (Cosmulescu et al., 2022); more than 200 varieties, forms and hybrids have been identified (Ghiorghiță et al., 2012c). This shrub provides food and habitat for some animals, while in horticulture, it is used as a rootstock for ornamental varieties of roses (Šindrak et al., 2012), it is one of the most widely used non-wood forest products (Güler et al., 2021). It can be planted to prevent soil erosion, as it is adaptable to different soils and environmental conditions. Few diseases or pests can seriously damage the adult plant (Šindrak et al., 2012). The fruit has a brick-red colour, to an intense red, with a pleasantly sour taste, and inside there are numerous small and hairy achenes (Iancu et al., 2020). Due to its proven effects on immunity, rosehip fruits quickly found a common usefulness, being found both in food (Eldaw & Çiftci, 2023) and in some medicines; the plant can also be found in feed, fuel, agriculture, tools, forest curtains, and even as a ritual element (Bozhuyuk et al., 2021). Traditionally, rosehips are used against many diseases due to their immunosuppressive, antioxidant, anti-inflammatory, antiarthritic, analgesic, antidiabetic, cardioprotective, antinociceptive, antimicrobial, gastroprotective, and skin ameliorative effects (Teodorescu et al., 2023). Unlike cultivated varieties, these wild fruits are famous for their intense aroma and fragrance, but they also show greater resistance to adverse soil and climatic conditions (Eyduran et al., 2022). The present paper aims to carry out an analysis of the variability of *Rosa canina* L. genotypes in some forest ecosystems located in the southern area of Olt County in order to develop and complete morphological knowledge regarding this species.

MATERIALS AND METHODS

The rosehip fruits (*Rosae fructus*) were harvested from plants of spontaneous flora in the south of Olt County, in the vicinity of forests located on the administrative territory of Vlădila, Studina and Grădinile communes. From the multitude of genotypes identified and analysed, using specific methods (fruit quality, productivity, disease resistance), nine genotypes were selected for analysis. They were located by GPS coordinates (Table 1) for further observation. For the coding of individuals, two letters represent the harvesting area (GR, ST; VL), two letters symbolize the species (RS), and a number. Vlădila Forest and Studinița Forest are protected areas and can also be identified by site names such as ROSCI0183 and ROSCI0174 respectively. Grădinile forest is located, according to Iancu & Iancu (2017), in the east, southeast, and northwest of the rural settlement.

Table 1. Encoding and GPS coordinates of identified *Rosa canina* genotypes

Genotype	GPS coordinates
GR RC 01	43°56'23"N 24°23'43"E
GR RC 02	43°56'31"N 24°24'03"E
GR RC 03	43°56'26"N 24°23'53"E
ST RC 01	43°58'14"N 24°24'50"E
ST RC 02	43°58'35"N 24°24'29"E
ST RC 03	43°58'36"N 24°24'21"E
VL RC 01	44°00'13"N 24°22'58"E
VL RC 02	44°00'21"N 24°21'56"E
VL RC 03	44°00'27"N 24°21'08"E

The climatic conditions of the three zones are similar since the distances between the studied forest habitats range from 2 to 10 km. Geographically, the studied forest habitats are located at the border between the Caracal Plain and the Leu-Rotunda High Field. The climate is forest-steppe, dry due to the unevenness of precipitation in the growing season and high temperatures (Stamin & Olaru, 2023). From a hydrological point of view, Vlădila Forest is crossed by Vlădila Creek, on which three reservoirs were built; in the case of Studinița Forest the nearest water source is Studina Pond at a distance of about 500 m, and the forests in Grădinile commune are near the Grădinile Creek and the three ponds of anthropogenic origin (Iancu & Iancu, 2017) located on the administrative territory. The soils mainly belong to the group of mollisols with cambic chernozems and clayey chernozems (Olaru & Cheptănariu, 2023).

Observations were made for 100 fruits of each genotype studied. With the help of the electronic caliper, the height of the fruit and two diameters, respectively, were measured in the middle area; taking into account that the fruit does not have a perfect shape, it was aimed that the two diameters are approximately perpendicular. The weight of each fruit was also determined using the analytical balance.

The obtained data were statistically processed through Microsoft Excel 2010, determining the mean value for each characteristic, genotype (X), standard deviation (SD), coefficient of variation (CV% = SD/X*100), histograms of measured parameters, and correlations between parameters.

RESULTS AND DISCUSSIONS

The values obtained for the morphological characteristics of the fruit are given in Table 2. The physical characteristics of fruits are a criterion for selecting valuable genotypes. The size and shape of the fruit determine the market. They vary both within the genotype and from genotype to genotype within the population. Regarding the height of the fruits, it can be found that the lowest measured value was 10.47 mm (VL RC 01), and the highest recorded height value was 27.68 mm (VL RC 02). In the study of Rosu et al. (2011), the limits of variation for rosehip were between 11.4 and 30.9 mm, similar to those obtained in this study. The average value for fruit height was 20.02 mm, with limits ranging from 21.86 mm (GR RC 02) to 18.34 mm (GR RC 01). The obtained results are comparable with the data presented by Rosu et al. (2011), for genotypes from Moldova area (16.8 and 24.0 mm). The coefficient of variation for all genotypes was 12.61%, which shows a lower variability compared to the research conducted by Stoenescu & Cosmulescu (2021), where the coefficient of variation was 16.47%, the genotypes being collected from another area of Oltenia, than the one in the present study.

Table 2. Morphological characteristics of the studied rosehips genotype

Genotype	Descriptive statistics	Fruit height (mm)	Small fruit diameter (mm)	Large fruit diameter (mm)	Fruit weight (g)
GR RC 01	X ± SD	18.34 ± 1.69	10.54 ± 0.92	10.71 ± 0.89	1.01±0.24
	Variations limit	14.52 - 21.69	8 - 13.51	8.45 - 13.69	0.55 - 1.74
	CV %	9.25	8.80	8.36	23.72
GR RC 02	X ± SD	21.86 ± 2.24	12.06 ± 1.26	12.34 ± 1.28	1.80 ± 0.54
	Variations limit	11.97 - 26.90	9.24 - 15.17	9.48 - 15.32	0.76 - 3.13
	CV %	10.28	10.47	10.43	30.09
GR RC 03	X ± SD	18.87 ± 1.83	9.67 ± 0.80	9.92 ± 0.80	1.05 ± 0.23
	Variations limit	13.12 - 23.65	7.89 - 12.1	8.23 - 12.16	0.43 - 1.68
	CV %	9.71	8.32	8.13	22.32
ST RC 01	X ± SD	20.81 ± 2.42	12.01 ± 1.52	12.19 ± 1.55	1.63 ± 0.37
	Variations limit	13.87 - 25.14	1.70 - 15.91	1.77 - 15.98	0.43 - 2.88
	CV %	11.65	12.72	12.76	22.99
ST RC 02	X ± SD	19.59 ± 1.41	11.01 ± 0.71	11.10 ± 0.71	1.30 ± 0.25
	Variations limit	15.83 - 22.75	9.34 - 13.09	9.42 - 13.11	0.77 - 2.21
	CV %	7.24	6.48	6.47	19.28
ST RC 03	X ± SD	21.15 ± 2.16	11.56 ± 1.09	11.97 ± 1.11	1.43 ± 0.30
	Variations limit	14.51 - 26.10	8.36 - 13.98	9.38 - 15.16	0.72 - 2.29
	CV %	10.21	9.42	9.30	21.13
VL RC 01	X ± SD	18.38 ± 2.57	10.62 ± 1.15	11.07 ± 1.17	1.05 ± 0.32
	Variations limit	10.47 - 26.61	7.76 - 13.41	8.08 - 13.82	0.42 - 1.92
	CV %	13.98	10.85	10.62	30.87
VL RC 02	X ± SD	21.33 ± 2.42	12.34 ± 1.45	12.61 ± 1.44	1.60 ± 0.48
	Variations limit	15.95 - 27.68	9.24 - 16.14	9.41 - 16.25	0.75 - 3.25
	CV %	11.38	11.81	11.42	30.52
VL RC 03	X ± SD	19.81 ± 2.71	11.31 ± 1.09	11.61 ± 1.18	1.37 ± 0.34
	Variations limit	11.76 - 25.50	8.70 - 15.5	9.00 - 16.59	0.68 - 2.65
	CV %	13.70	9.68	10.19	25.22
All genotypes	X ± SD	20.02 ± 2.52	11.23 ± 1.40	11.50 ± 1.41	1.36 ± 0.44
	Variations limit	10.47 - 27.68	1.70 - 16.14	1.77 - 16.59	0.42 - 3.25
	CV %	12.61	12.47	12.33	32.86

Regarding the small diameter of fruit, the variations ranged from 1.70 mm (ST RC 01) to 16.14 mm (VL RC 02). The mean value was 11.23 mm, with limits ranging from 9.67 mm (GR RC 03) to 12.34 mm (VL RC 02). Roman et al. (2012), determined values between 8.7 and 14.2 mm for the average fruit diameter for rosehip genotypes from Transylvania.The observations made by Stoenescu & Cosmulescu (2021) show an average diameter value for all analysed genotypes of 13.00 mm. The coefficient of variation of small diameter for all genotypes is 12.47%, which shows uniform fruits for this characteristic. As for the large diameter, the data are approximately similar, the average value being 11.50 mm and the coefficient of variation having a calculated value of 12.33%. The variation limits for the mean diameter ranged from 9.92 mm (GR RC 03) to 12.61 mm (VL RC 02). For this characteristic, Benković-Lačić et al. (2022) specify average values between 13.07 and 13.28 mm for Croatian genotypes, and Tomljenović et al. (2021), between 11.36 and 15.17 mm. The weight of fruits has the widest limits, highlighted by the values of variability (19.23-30.87%), which can be explained by the fact that each genotype has a different maturation stage. The weight variation limits ranged from 0.42 g (VL RC 01) to 3.25 g (VL RC 02). The mean weight value of all genotypes analysed was 1.36 g. Regarding the coefficient of variation, the values were between 19.28% (ST RC 02) and 30.87% (VL RC 01), with an average value of 32.86%. A lower variability coefficient (18.90%) was calculated by Durul et al. (2023). These results also indicate a large variation in this trait with a notable influence of environmental factors, a fact also supported by Tomljenović et al. (2022).

Considering the recorded variability, a series of four histograms for each determined parameter was performed (Tables 3-6). Histograms visually interpret numerical data by indicating how many data points are within a range of values. The histogram is the most commonly used graph to show frequency distributions. Table 3 shows the grouping of fruits by fruit height. The height values were divided into 29 classes, but the maximum number of fruits (91) was in the range of values 20.22-20.80 mm, followed by the range 19.65-21.37 mm (83 fruits grouped into two classes); 28.56% of the analysed fruits have values between 20.22-21.37 mm, or 53.56% of fruits had values between 19.08-21.94 mm. The distribution of this histogram is uninomial, and the frequency curve appears asymmetrically positive.

Table 3. The fruit height histogram

Bin	*Freq*	*Cumulative %*	*Bin*	*Freq*	*Cumulative %*
20.80	91	10.11%	24.24	21	90.78%
20.22	83	19.33%	15.63	18	92.78%
21.37	83	28.56%	16.21	13	94.22%
19.65	79	37.33%	25.39	13	95.67%
19.08	77	45.89%	15.06	10	96.78%
21.94	69	53.56%	25.96	7	97.56%
18.50	61	60.33%	14.49	5	98.11%
22.52	56	66.56%	12.19	3	98.44%
17.93	42	71.22%	13.91	3	98.78%
16.78	37	75.33%	26.53	3	99.11%
23.09	36	79.33%	27.11	3	99.44%
17.35	35	83.22%	13.34	2	99.67%
23.66	24	85.89%	10.47	1	99.78%
24.81	23	88.44%	11.62	1	99.89%
			More	1	100.00%

Table 4 contains the histogram made for the parameter called the small diameter of the fruit and records a number of 19 classes, of which the one with the highest frequency is the class with limits of variation between 10.85-11.81mm (144 fruits; 16%). However, 88.89% of the values for large diameter are grouped into nine value points, as shown by the analysis of the data presented in Table 4. 64.33% of the analysed fruits had values between 10.36-12.29 mm and were divided into five classes of values.

Table 4. Histogram of the small diameter of the fruit

Bin	*Freq*	*Cumulative %*	*Bin*	*Freq*	*Cumulative %*
11.81	144	16.00%	14.21	15	94.11%
10.85	131	30.56%	8.44	14	95.67%
11.33	111	42.89%	8.92	14	97.22%
10.36	100	54.00%	14.70	12	98.56%
12.29	93	64.33%	15.18	4	99.00%
12.77	73	72.44%	15.66	3	99.33%
9.88	59	79.00%	More	3	99.67%
13.25	45	84.00%	7.96	2	99.89%
9.40	44	88.89%	1.70	1	100.00%
13.73	32	92.44%			

The histogram for the large diameter of the fruit is shown in Table 5.

Table 5. Histogram of the large diameter of the fruit

Bin	*Freq*	*Cumulative %*	*Bin*	*Freq*	*Cumulative %*
12.14	130	14.44%	9.18	16	95.11%
11.65	127	28.56%	14.61	14	96.67%
11.16	120	41.89%	8.69	11	97.89%
10.66	105	53.56%	15.60	6	98.56%
12.64	85	63.00%	15.11	5	99.11%
13.13	80	71.89%	16.10	4	99.56%
10.17	69	79.56%	More	2	99.78%
9.67	51	85.22%	1.77	1	99.89%
14.12	37	89.33%	8.19	1	100.00%
13.63	36	93.33%			

The values were grouped into 19 classes, but 89.33% were grouped into only nine classes. The highest frequency value was recorded in the class 11.65-12.14 mm (130 values, representing 14.4%). As in the previous case (small diameter), 63% of fruits were classified into five classes, with variation limits between 10.66-12.64 mm.

Table 6 refers to weight, representing the histogram for this parameter. The weight of the fruit is an important character of quality. The values obtained for this characteristic were divided into 30 classes of values, much more than for the diameter of the fruit. The maximum value reached by absolute frequency was 89 fruits for grades 1.27-1.36 g, representing 9.88%. However, even for this characteristic, 44.89% of fruits weighed between 0.99 and 1.55 g. Only 4.67% of values were contained in 13 classes.

Table 6. The fruit weight histogram

Bin	*Freq*	*Cumulative %*	*Bin*	*Freq*	*Cumulative %*
1.36	89	9.89%	2.02	16	92.67%
1.27	88	19.67%	2.21	16	94.44%
1.17	77	28.22%	2.31	8	95.33%
0.99	75	36.56%	2.50	8	96.22%
1.55	75	44.89%	2.59	6	96.89%
1.08	66	52.22%	0.61	5	97.44%
1.46	63	59.22%	2.40	4	97.89%
1.65	55	65.33%	2.68	4	98.33%
0.89	52	71.11%	2.87	4	98.78%
1.74	46	76.22%	2.78	3	99.11%
1.93	31	79.67%	2.97	3	99.44%
0.80	29	82.89%	0.51	2	99.67%
1.84	29	86.11%	0.42	1	99.78%
0.70	22	88.56%	3.16	1	99.89%
2.12	21	90.89%	More	1	100.00%

In order to establish the correlation between the two studied variables, the correlation (r) and determination (R^2) coefficients between the morphological characteristics of fruits in the analysed genotypes were calculated. The determined values are shown in Table 7. As can be seen for all calculated correlations, the value of r is between 0 and 1, which denotes that regardless of the pairs of grouped parameters, the values tend to increase or decrease together. As expected, the closest value to 1 is the correlation between the two diameters (r = 0.979). There are high values for both the weight-height correlation of the fruit (r = 0.717) and the weight - diameter of the fruit (r = 0.830).

The coefficient of determination (R^2) is a statistical measurement that examines how the difference in a second variable can explain differences in one variable. From the data obtained (Table 7) it appears that between 54.15 and 73.65% of the weight of the fruit is predicted by the dimensions of the fruit (height and diameters). Only 24.89% of the large diameter variable and 26.86% of the small diameter influence the height of the fruit, which indicates that the shape of the fruit is a genetic character characteristic of each genotype.

Table 7. The correlations of the studied parameters

*	Indices	H (mm)	d (mm)	D (mm)
H (mm)	R^2	1		
	r	1		
d (mm)	R^2	0.2686	1	
	r	0.556	1	
D (mm)	R^2	0.2498	0.9587	1
	r	0.543	0.979	1
G (g)	R^2	0.5415	0.7365	0.7312
	r	0.717	0.830	0.830
*H= Fruit height; d= Small fruit diameter; D= Large fruit diameter; G= Fruit weight				

The value of 0.9587 of the coefficient of determination between the two diameters suggests that 95.87% of the dependent variable (D) is predicted by the independent variable (d).

CONCLUSIONS

Although the studied areas are quite close geographically, the differences between genotypes are significant, with a rather large variability of *Rosa canina* L. in the southern area of Olt County, especially regarding fruit weight. The limits of variation are vast, both within and between genotypes, including increased variability. Comparing with the above-mentioned literature, it can be accepted that the fruits studied are of medium size but may constitute biological material for both research and recovery.

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