

Morphometric and Meristic Characteristics of the Wild Strawberry (*Fragaria vesca* L.) on Konjuh Mountain

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Abstract: Rosaceae is a numerous family including 115 genera and more than 3000 species spread throughout the world. The genus *Fragaria* (strawberry) embraces perennial herbaceous plants. The existing material was collected during different seasons and phenophases of the species at topographically and environmentally different locations around Tuzla. Parallel morphological analyses revealed that the species *Fragaria vesca* L. shows a high degree of variability for the traits analysed. Therefore, a detailed understanding of the morphological variability and ecological differentiation of the species population is an essential condition for the assessment of the biological potential and evolutionary status of the test herb.

Key words: Morphological characteristics, ecological differentiation, variability.

Introduction

Throughout their genotype-dictated growth, plants respond flexibly to a complex set of factors in the environment. Over time, new inherited characteristics are formed and combined with the already existing ones to create new mutually different organisms. Phenotypic plasticity is of evolutionary significance, acting as a potential adaptation mechanism for the heterogeneity of the habitat (Schilichting 1986).

Hence, detailed understanding of the morphological variability and ecological differentiation of the population of a species is seen as an essential condition for the assessment of the biological potential and the evolutionary status

of the plant analysed (Tucić 1987). According to the level of biodiversity, the family Rosaceae is qualified as the most complex taxa.

This family comprises 115 genera and over 3000 species. Systematically, it is often divided into 4 subfamilies: Spiraeoideae, Rosoideae, Maloideae (Pomoideae) and Prunoideae, according to (Fiori 1921), (Javorka 1925). In order to ensure exactness of data for future systematic research on *Fragaria vesca* L., the following objectives were defined.

Identify types and levels of individual, population and inter-population variability of the species *Fragaria vesca* L., depending on environmental factors under which they develop; Identify the most variable and most consistent morphological characters that can be used. Critical taxonomic analysis and revision of this variable taxon and related taxa of the Rosaceae family.

Materials and Methods

The floristic material analysed for the morphological variability of *Fragaria vesca* L. taxa was collected during 2006, in different seasons and phenophases of the species and at topographically and environmentally different sites of Mt. Konjuh.

Tab. 1. Overview of research sites

Locality	Altitude	Latitude	Longitude	Community	Date
Men's water Kladanj (1)	729 m	44°14' 012" (N)	18°36' 460" (E)	Abieti-Fagetum fragarietosum vescae	30/05/06
Zlaca (the bridge) (2)	412 m	44°21' 190" (N)	18°34' 007" (E)	Fagetum montanum «serpentinicum»	28/05/06
Zlaca (the road) (3)	393 m	44°21' 133" (N)	18°33' 922" (E)	CampanuloPrunelletum at the rim of Abieti-Fagetum «serpentinicum»	28/05/06

In order to achieve the set objectives, field and laboratory research were conducted, and appropriate working methods were applied. The field research involved determination of non-biotic and biotic factors of the habitat of each of the observed population, determination of phenological data and collection of samples and herbarium material. The related photographic documentation was also made.

Morphological and meristical macro-characters

The macro-morphometric characters analyzed included the following (Figure 1):

- Height (length) of plants with flowers (1)
- Total length of leaf with leaf stem (2)
- Length of leaf stem rate rose (3)

- Length of central lobe rate rose (4)
- Maximum width of middle lobe of the leaf (5)
- The length of the first lobe rate rose (6)
- The maximum width of the first lobe rate rose (7)
- Length of floral stems (8)
- The length of internal sepal ballots (9)
- The maximum width of the inner sepal ballots (10)
- Length of petals (petal ballots) (11)
- The maximum width of petals (12)
- Number of barbs in the middle lobe rate rose from one side (13)
- The length of external sepal ballots (14)
- Maximum width outside sepal ballots (15)



Fig. 1. Analyzed morphologically characters of *Fragaria vesca* L

Results and Discussion

A high degree of variability was determined from the characters observed, which, consequently, differentiates the average morphological features of individuals from different populations, according to Redžić (1988a, 1988b). External stimulation affects the population phenotype *Fragaria vesca* L., as confirmed by investigations conducted at the morphological and molecular level of *Fragaria vesca* L. population between populations (*F. chiloensis* and *F. virginiana*) (Harrison *et al.* 1997, 2000, Potter *et al.* 2000, Bors 2000).

The size of the tested characters in this locality is determined by the amount of light, which is confirmed by other researchers (Neskovic *et al.* 2003). Aiming at morphological differentiation of populations under different ecological conditions, the (morpho) ecotype is described as follows:

Tab. 2. Locality: Men's water – Kladanj

<i>Loc</i>	<i>Var</i>	<i>N</i>	$\bar{X}$	$X_{\min}$	$X_{\max}$	<i>Range</i>	<i>S</i>	$S\bar{x}$	<i>V</i> (%)
1	V1	30	143.400	82	212	130	38.647	7.056	26.951%
1	V2	30	142.000	89	231	142	34.717	6.338	24.448%
1	V3	30	105.200	60	168	108	28.984	5.292	27.552%
1	V4	30	40.133	24	63	39	8.943	1.633	22.284%
1	V5	30	26.133	17	41	24	5.782	1.056	22.124%
1	V6	30	34.800	21	55	34	7.645	1.396	21.968%
1	V7	30	23.300	15	38	23	6.047	1.104	25.951%
1	V8	30	11.533	8	20	12	2.945	0.538	25.532%
1	V9	30	4.433	3	6	3	0.751	0.137	16.945%
1	V10	30	1.983	1.5	2.5	1	0.207	0.038	10.433%
1	V11	30	4.133	3.5	6	2.5	0.615	0.112	14.878%
1	V12	30	3.567	3	5	2	0.537	0.098	15.060%
1	V13	30	9.200	7	12	5	1.349	0.246	14.667%
1	V14	30	4.233	3	6	3	0.679	0.124	16.037%
1	V15	30	1.017	1	1.5	0.5	0.091	0.017	8.979%

The population of individuals at the site Men's Water, Kladanj develops under mesophyllic but colder conditions than most other populations observed. Size of specimens is relatively small compared to individuals within deforested places and open meadow habitats. The flowers are also relatively small, and fruits are mostly elongated. Variations within the population are relatively high, as indicated by the range between minimum and maximum recorded value of the character.

Tab. 3. Locality: Zlaca (bridge)

<i>Loc</i>	<i>Var</i>	<i>N</i>	$\bar{X}$	$X_{\min}$	$X_{\max}$	<i>Range</i>	<i>S</i>	$S\bar{x}$	<i>V</i> (%)
2	V1	30	201.333	95	292	197	51.293	9.365	25.477%
2	V2	30	164.233	79	227	148	36.797	6.718	22.406%
2	V3	30	116.867	50	169	119	28.981	5.291	24.799%
2	V4	30	46.900	29	66	37	9.707	1.772	20.698%
2	V5	30	32.000	22	41	19	5.252	0.959	16.413%
2	V6	30	40.100	22	55	33	8.389	1.532	20.919%
2	V7	30	29.667	19	43	24	5.915	1.080	19.939%
2	V8	30	22.800	7	53	46	11.006	2.009	48.272%
2	V9	30	4.350	3	5.5	2.5	0.589	0.108	13.550%
2	V10	30	2.333	1.5	3	1.5	0.330	0.060	14.162%
2	V11	30	4.067	3	5.5	2.5	0.751	0.137	18.473%
2	V12	30	3.067	2	4.5	2.5	0.763	0.139	24.868%
2	V13	30	8.467	6	11	5	1.332	0.243	15.734%
2	V14	30	3.633	2	5	3	0.765	0.140	21.052%
2	V15	30	1.267	1	1.5	0.5	0.254	0.046	20.030%

Individuals of the Zlaca – road populations also develop the anthropogenic eutritic cambisol community in the temperate deciduous forest. As the population in question is developing at the edge of the forest, struggling for sunlight, individual plants having a relatively long leaf handle developed. (Redžić 1990).

Tab. 4. Locality: Zlaca – road

<i>Loc</i>	<i>Var</i>	<i>N</i>	$\bar{X}$	$X_{\min}$	$X_{\max}$	<i>Range</i>	<i>S</i>	$S\bar{x}$	<i>V</i> (%)
3	V1	30	153.100	67	298	231	51.500	9.403	33.638%
3	V2	30	151.900	55	243	188	45.973	8.394	30.265%
3	V3	30	108.100	14	174	160	39.344	7.183	36.396%
3	V4	30	39.133	15	67	52	11.255	2.055	28.760%
3	V5	30	26.167	13	44	31	8.090	1.477	30.919%
3	V6	30	32.967	14	55	41	9.496	1.734	28.804%
3	V7	30	23.767	12	40	28	7.578	1.384	31.885%
3	V8	30	19.333	6	33	27	6.542	1.194	33.838%
3	V9	30	3.667	2	5	3	1.093	0.200	29.818%
3	V10	30	1.817	1	3	2	0.565	0.103	31.074%
3	V11	30	4.017	2	6	4	1.004	0.183	25.000%
3	V12	30	3.367	2	5	3	0.706	0.129	20.979%
3	V13	30	8.867	6	16	10	2.063	0.377	23.271%
3	V14	30	3.350	1.5	5	3.5	0.930	0.170	27.757%
3	V15	30	1.267	1	1.5	0.5	0.254	0.046	20.030%

Site 1: site 2 (Zlaca - bridge). Statistically significant differences were identified for the following characters (Table 5).

Tab. 5. Characters showing statically significant differences

Character	Significance
Height of plants with flowers	p = 0.0000
Floral stem length	p = 0.0000
Maximum width of external sepal ballots	p = 0.0000
Length of middle lobe rate rose	p = 0.0068
Beam of the middle lobe rate rose	p = 0.0001
Maximum width of the first lobe rate rose	p = 0.0001
Maximum width of petals	p = 0.0048
Length of external sepal ballots	p = 0.0021

Low statistically significant differences were identified for the characters: total length of leaf with leaf stem, the length of the first lobe rate rose and the number of teeth on the middle lobe rate rose with one hand. No statistically significant differences were identified among other characters.

Site 1: Site 3 (Zlaca - road). Statistically significant differences were identified for the following characters (Table 6).

Tab. 6. Characters showing statically significant differences in localities 1 and 10

Character	Significance
Floral stem length	p = 0.0000
Length of internal sepal ballots	p = 0.0025
Length of external sepal ballots	p = 0.0001
Maximum width of external sepal ballots	p = 0.0000

Site 2: Site 3 (Zlaća - road). Statistically significant differences were identified for the following characters (Table 7).

Tab.7. Characters showing statically significant difference in localities 9 and 10

Character	Significance
Height (length) of plants with flowers	p = 0.0006
Length of central lobe rate rose	p = 0.0058
Beam middle lobe rate rose	p = 0.0016
Length of the first lobe rate rose	p = 0.0031
Maximum width of the first lobe rate rose	p = 0.0014
Length of internal sepal ballots	p = 0.0038
Maximum width of the inner sepal ballots	p = 0.0001

The other characters did not show statistically significant differences.

Conclusions

Comparative analysis of data on the variation of individual characters in the locality (1) Men's Water suggests that the lowest percentage of variability was recorded for maximum width of external sepal ballots (KV = 8.979%), and maximum width of internal sepal ballots (K = 10.433%).

Comparative analysis of data on the variation of individual characters in the locality (2), Zlaća – the bridge clearly shows that the lowest coefficient of variation was recorded for the length of the inner sepal ballots (KV = 13.550%).

Comparative analysis of data on the variation of individual characters in the locality (3), Zlaća - the road show that the lowest coefficient of variation was recorded for the maximum width of the outer sepal ballots (KV = 20.030%) and maximum width of petals (KV = 20.979%).

A specific response to the dynamic (changing) values of environmental factors in the variability of morphological and meristic characters was expressed, testifying to the adaptation to environmental factors and utilization of capacity and potential habitat.

The morphological characters tested are variable, and the changes and differences among populations are not stable. Further stronger ecological isolation does not lead to stronger morphological differentiation of the same character or group

of characters. Greater morphological differentiation is to be achieved by increasing the number of differentiating characters. In the latter case, some differential characters may lose the characteristic and differentiation among populations can be achieved through other characters.

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MORFOMETRISKE I MERISTIČKE KARAKTERISTIKE ŠUMSKE JAGODE (*Fragaria vesca* L.) NA PLANINI KONJUH

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Rezime

Porodica Rosaceae je mnogobrojna i obuhvata 115 rodova sa više od 3000 vrsta, rasprostranjena je širom svijeta. Rod *Fragaria* (jagoda) obuhvata višegodišnje zeljaste biljke. Živi materijal je prikupljen u različitim sezonama i fenofazama odabrane vrste i topografsko – ekološki različitim lokalitetima na planini Konjuh. Provedenim uporedno morfološkim analizama je konstatovano da vrsta *Fragaria vesca* L. pokazuje visok stupanj varijabilnosti za većinu analiziranih karaktera. Dakle, detaljno upoznavanje morfološke varijabilnosti i ekološke diferencijacije populacija unutar vrste, neophodan je uslov za cijelovito sagledavanje biološkog potencijala i evolucionog stanja u kome se analizirana grupa biljaka nalazi.