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# Phenotypic variation in *Helichrysum arenarium* (L.) Moench from natural habitats

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The characteristic of habitats and communities with abundance of *Helichrysum arenarium* has been given. A morphometric study of *H. arenarium* traits has been carried out, and the data have been subjected to analysis of variance. The variability of quantitative characters within a population was found higher than between the populations. Relationship between the flower color and other parameters has been determined. The characters of the orange flower plants were much higher than in other color groups.

**Key words:** *Helichrysum arenarium*, habitat, phenotypic variation, morphometric analysis

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## INTRODUCTION

Medicinal and aromatic plants (MAP) represent a relevant part of the natural biodiversity. Their role has been increasingly acknowledged for herbal medicinal products. Progress in pharmacognosy has not been accompanied by equal advancements in the knowledge on the distribution, genetic diversity, ecology and conservation of MAP species [1]. The genetic erosion of MAP is occurring in two ways: through harvesting from the wild and destruction of natural habitats. It raises the importance of germplasm conservation of this group of plant. Active conservation of MAP is conducted within the context of National PGR program (1998–2002). One of the target species for conservation is *Helichrysum arenarium* (L.) Moench [2] whose larger habitats are known in the southeastern part of Lithuania. However, natural sources of the raw material are poor and harvesting from the wild causes an impoverishment and decrease of populations.

The aim of this work is to elucidate the ecological adaptability and the phenotypic diversity in *H. arenarium* and to determine the most important characters as a basic for selection of valuable accessions.

## MATERIAL AND METHODS

Investigations of *H. arenarium* were carried out on natural populations in Varėna district. The material studied was collected in 1999–2000. In the field research, the method of the Braun-Blanquet was used. The area of the study plot was 10 m<sup>2</sup>. The nomencla-

ture of phytocenoses was used according to the Lithuanian [3] and European class systems [4–5]. Also, a syntaxonomic analysis of the plant communities was carried out, using the coefficient of floristic significance (V, %) proposed by M. Natkevičaitė-Ivanauskienė [6]. The chemical composition of the soil (pH<sub>KCL</sub>, active P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O, total N, humus) was determined in the zone of rhizosphere.

Morphometric analysis in *H. arenarium* has been performed on reproductive shoots. A total of 10 traits was measured in 30 randomly selected individuals from 35 stands in wild.

The data were analyzed using the SPSS/PC+ computer package. Differences among groups were tested by one-way analysis of variance (ANOVA).

## RESULTS

**Habitats characteristic.** The communities in which *H. arenarium* occurred more abundantly were formed of species from different classes. The coefficient of floristic significance (V, %) of each class in explored communities was determined (Table 1). *Koelerio-Corynephoretea* communities had the highest significance (28.32%) among other vegetation classes. The communities were allocated to the *Koelerion glaucae* (Volker 1931) Klika 1935 order, *Sedo-Scleranthetalia* Br. Bl. 1955 alliance and *Festuco pole-sicae-Koelerietum glaucae* Bandžiliūnienė 1985 association. Characteristic species in the community are *Helichrysum arenarium*, *Hieracium pilosella*, *Corynephorus canescens*, *Rhacomitrum canescens*. Constantly grew: *Sedum acre*, *Trifolium arvense*, *Thymus serpyll-*

lum, *Jasione montana*. In addition to *Koelerio-Corynephoretea*, the species of the *Rudero-Secalietae*, *Festuco Brometea*, *Molinio-Arrhenatheretea* classes were more significant. The number of *Molinio-Arrhenatheretea* species predominated and were represented by xeromesophytes, however, their abundance was low. It should be noted that the communities contained many accidental species, among which segetal species such as *Scleranthus annuus*, *Berteroa incana*, *Oenothera biennis*, *Echium vulgare* prevailed. Species composition showed the xerophilous character of the communities. The number of species reached 7 to 27 per relevé. The herbaceous cover was thinned out (relative cover 20–50%). The moss layer varied in a wide range (10–60%).

with a low content of nitrogen. They contained varying amounts of phosphate and a low concentration of potassium. The variation of mineral nutrients in different stands was rather high (Table 2).

The variation of quantitative and qualitative characters in *H. arenarium* has been studied. The oneway analysis of variance (ANOVA) revealed significant differences ( $p < 0.001$ ) among populations within the majority of characters (Table 3). The peak values of F statistics in *H. arenarium* were observed for the height of shoots, the number of flowers per calathid, the number of calathids per shoot, the length of raceme. The width of leaves did not differ significantly in the populations. The weight of racemes and vegetative part, as well as the length of racemes and the number of calathids per shoot proved to be the most variable traits showing the highest variability coefficient (Table 4). The lowest variability was noted for the width and length of leaves, as well as for the number of flowers per calathid. The variability among the individuals within the populations was higher than among the populations for all characters.

**Table 1. The floristic significance of vegetation classes in communities with *Helichrysum arenarium***

Vegetation class	Floristic significance (V, %)
<i>Koelerio-Corynephoretea</i> Klika et Nowak 1941	28.32
<i>Rudero-Secalietae</i> Br. Bl. 1936	18.78
<i>Festuco Brometea erecti</i> Br. Bl. et R. Tx. 1943	16.09
<i>Molinio-Arrhenatheretea elatioris</i> R. Tx. 1937	15.00
<i>Nardo-Callunetea</i> Prsg. 1949	14.34
<i>Betulo-Pinetea</i> Prsg. et Knapp 1942	9.69
<i>Rubo-Sambucetea</i> (Doing, 1961) Pass. 1963	5.94
<i>Trifolio-Geranietea sanguinei</i> Th. Müller 1961	4.28

The communities are described as the last successional stage of meadows that are in the phase of transformation into woods [3]. Such communities are frequent in South Lithuania and are situated on dry, sandy soils of a plain or wavy relief. They are characterized by a very acid to neutral reaction of soils (pH 4.11–6.78; CV = 14.42%). The habitats of middle acidity make up 31.8%, slightly acid 27.3% and very acid 13.6%. A. L. Švambaris [7] pointed out that *H. arenarium* occurs on slightly acid and neutral soil habitats. All data showed *H. arenarium* to be widespread in more or less acid soils and absent in alkaline habitats. The soils are poor in humus

The color of *H. arenarium* flowers varies from citric to orange. In the populations under investigation the majority of plants had citric yellow racemes (51%), fewer plants had yellow or citric racemes (26 and 16% respectively), and just a few occasional plants had orange or even brown racemes. The plants with orange racemes could be treated as a morphological form – *f. aurantiacum* (Pres.) Bleck [8].

The relationship of color with the other parameters has been scrutinized (Figure). The results of analysis of variance showed that the investigated parameters significantly differed ( $p < 0.001$ ) among the plants from different flower color groups. Yellow flowers made the least number of calathids, and the orange ones prevailed. The weight of orange racemes was significantly higher than of other color groups. Citric and yellow racemes had the least weight. The parameters of orange and citric yellow racemes were the largest. The widest leaves were of the plants that had citric yellow and yellow flowers and the narrowest of the orange and citric flower plants. One can find a relationship between the flower color and the leaflet shape. The shape of the leaflet of the orange flower plants in 84% of cases (and in 75% for the citric ones) is obtuse. The leaves of the yellow flower plants more often (in 64% of cases) are sharp.

**Table 2. Chemical composition of soil in the habitats of *Helichrysum arenarium***

Character	M ± m	Range	CV, %
pH <sub>KCl</sub>	5.21 ± 0.16	4.11–6.78	14.42
N (common), %	0.096 ± 0.008	0.034–0.105	44.43
P <sub>2</sub> O <sub>5</sub> , mg/kg	110.55 ± 20.65	30.0–250	42.02
K <sub>2</sub> O, mg/kg	36.71 ± 3.22	26.5–58.9	16.68
Humus, %	1.09 ± 0.31	0.32–1.73	34.25

M – mean, m – standard error, CV – coefficient of variation.

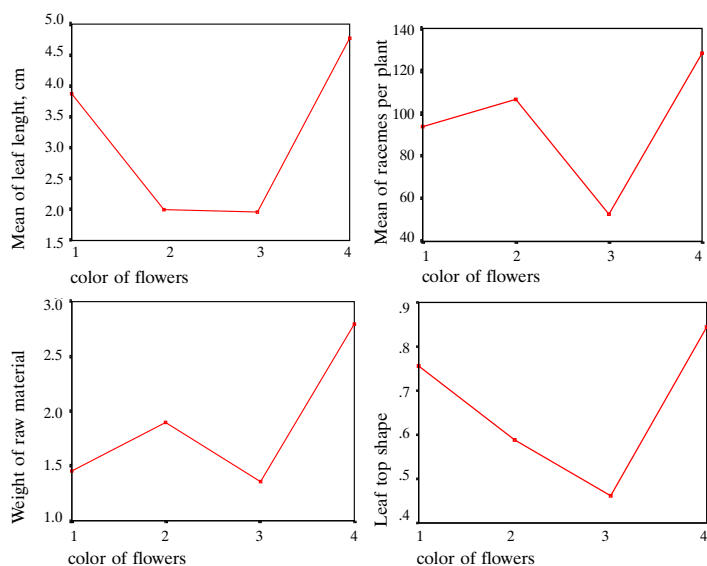
Table 3. Analysis of variance for *Helichrysum arenarium* characters

Character	Degrees of freedom		Fisher's statistics	Significance level
	between groups	within groups		
Height, cm	34	625	12.495	0.001
Number of calathids per shoot	34	624	7.295	0.001
Number of flowers per calathid	34	625	10.862	0.001
Width of leaf, cm	11	228	1.753	0.63
Length of leaf, cm	11	228	3.754	0.001
Width of raceme, cm	11	228	4.382	0.001
Length of raceme, cm	11	228	5.039	0.001
Weight of raw material, g	11	228	3.748	0.001
Weight of vegetative part, g	11	228	4.256	0.001

Table 4. Characteristic of *Helichrysum arenarium* traits and their variation within and among populations

Character	M	SE	Range	CV <sub>1</sub> , %	CV <sub>2</sub> , %
Height, cm	21.48	0.2	8.4–45	23.8	15.39
Number of calathids per shoot	25.87	0.44	7–90	43.4	23.81
Number of flowers per calathid	31.51	0.32	11.3–60	26	15.69
Width of leaf, cm	0.2	0.003	0.1–0.5	36.5	10.69
Length of leaf, cm	2.88	0.03	1.2–3	26.2	17.29
Width of raceme, cm	2.21	0.03	0.5–5	31.2	13.58
Length of raceme, cm	1.97	0.03	0.5–8.2	38	17.45
Weight of raw material, g	0.35	0.02	0.05–5	83.4	56.26
Weight of vegetative part, g	0.58	0.02	0.1–4.2	75.5	45.05

M – mean, SE – standard error, CV<sub>1</sub> – coefficient of variation within the population, CV<sub>2</sub> – coefficient of variation between populations.



Color of flowers: 1 – citric, 2 – citric yellow, 3 – yellow, 4 – orange.

Figure. Relationship of color of flowers and leaf length, number of racemes, weight of raw material, and leaf top shape (sharp – 0, obtuse – 1) in *Helichrysum arenarium* according to the results of analysis of variance

A considerable morphological variation was observed in *H. arenarium* wild populations. The plants belonging to the same population showed a large range of variation in the main characters such as mass of racemes and vegetative part of shoots, number of calathids. A highly phenotypic variation of *H. arenarium* may allow selecting the most valuable accessions. While continuing the selection of *H. arenarium* in wild populations, it is important to pay more attention to the orange flower plants because of the weight of racemes and other parameters of these plants which are much higher than in other color groups. Longer leaves with the obtuse top indicate a higher probability of orange flowers – all this makes these parameters very important at the primary stages of selection. The gathering and further selection of accessions of this species should be done for a single plant, as the variability within populations is higher than among populations. Further evaluation of the accessions in the field collec-

tion while monitoring the influence of ecological conditions would be more objective.

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#### FENOTIPINIS *HELICHRYSUM ARENARIUM* (L.) MOENCH ĮVAIRAVIMAS NATŪRALIOSE AUGIMVIETĖSE

#### S a n t r a u k a

Aprašytų smėlinio šlamučio augimviečių žolyno rūšinės sudėties analizė parodė, kad bendrijas sudaro įvairių klasių augalai. Sintaksonomiškai reikšmingiausia (28,32%) yra *Koelerio-Corynephoretea* klasė. Bendrijos su smėliniu šlamučiu priskirtos *Festuco polesicae-Koelerietum glaucae* asociacijai. Augimviečių dirvožemiai dažniausiai rūgštūs, su mažu makroelementų kiekiu.

Kiekybinių ir kokybinių fenotipinių šlamučio požymių dispersinė analizė atskleidė reikšmingą jų skirtumą tarp tirtų cenopopuliacijų, išskyrus lapo plotį. Požymių įvairovė cenopopuliacijų viduje yra didesnė nei tarp jų. Nustatyta reikšminga kiekybinių šlamučio parametrų ir žiedynų spalvos priklausomybė. Oranžinius žiedynus turintys augalai išsiskyrė didžiausiais žiedynais, gerokai dažniau turėjo bukus lapus. Vykdamas tolesnę šlamučio atranką gamtoje, atkreiptinas dėmesys į augalus oranžiniais žiedynais.