

Seasonal variation in *Melampyrum pratense* a morphological point of view



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Introduction

The seasonal variation is a common phenomenon in many hemiparasitic genera of the former family Scrophulariaceae. This term refers to the situation when different populations of one species flower in different periods of the year. In addition to the flowering period, the number of internodes and of intercalary internodes (i. e. internodes between the uppermost branches and the lowest flowers of the terminal inflorescence), number of branches and of flowering branches are the most important seasonal characters. The leaf and bracts width and length are also partly polymorphic with respect to this type of variation. The taxonomic value of seasonal variation is different among individual genera. It is traditionally regarded to be important in genus *Melampyrum* on the infraspecific level. Initially, two basic seasonal types were described - aestival type (early-flowering, with few internodes, one intercalary internode, and a few short branches), and autumnal type (late-flowering, with many internodes, some intercalary internode, and many flowering branches - Fig. 1). The number of recognised types was increasing by time and some types were related to specific ecological conditions (e.g. peatbogs). So the phenomenon started to be described as a "pseudoseasonal polymorphism" and the types were called "ecotypes" or "ecotypic variants".

Melampyrum pratense is probably the most polymorphic species of genus *Melampyrum*, and part of its variation is not related to seasonality. But the seasonal characters were counted as the most important by majority of former botanists. The variation of *M. pratense* was studied in detail in several papers and the reticulate nature of many morphological characters was recognised. In spite of these findings, treatments based on the seasonal characters still occur.

Main study aims

- 1) Changes in seasonal characters over the flowering period in particular populations of *M. pratense*.
- 2) Morphometric study of *M. pratense* in Central Europe
- 3) Taxonomic interpretation of discovered pattern of seasonal variation of *M. pratense*

Material & Methods

About 3400 plants of *Melampyrum pratense* were studied from 90 populations from the Czech Republic, Slovakia and Austria (Fig. 2). In order to study changes in seasonal characters within one population over the flowering period, some populations were studied repeatedly using several population samples (consisting of 20-30 plants).

Eleven characters were measured on each plant: stem height (S), number of internodes (I), number of intercalary internodes (II), number of branches (more precisely branch pairs; B), flowering branches (FB), leaf width (LW), leaf length (LL) and distance of the widest leaf part from the leaf base (LD), and the same measurements on the first bract (BW, BL and BD).

The change in observed characters in the course of the vegetation period was evaluated by RDA (redundancy analysis). RDA was carried out using CANOCO 3.12. The principal component analysis (PCA) performed on the character correlation matrix was used as the ordination method for individual population samples, characterized by the mean value of the observed characters. Then each plant was projected to the diagram displaying the first two ordination axes. The PCA was carried out using the Syntax 5.02 package.

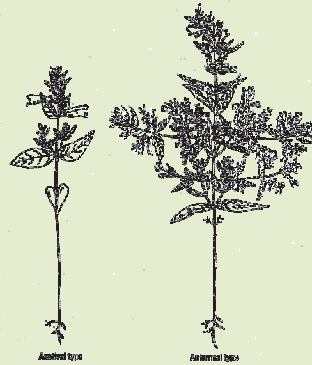


Fig. 1 A typical habit of "aestival" and "autumnal" plant of *M. pratense*

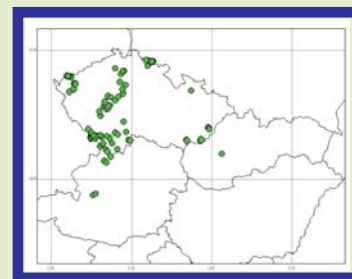


Fig. 2 Localities of studied populations of *M. pratense*

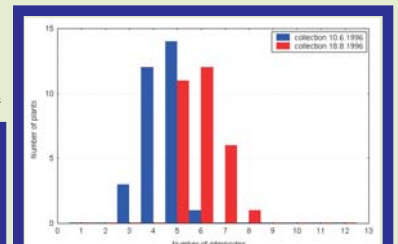


Fig. 3. Changes in the frequency distribution of internodes in the course of the flowering period at a locality in the South Bohemia

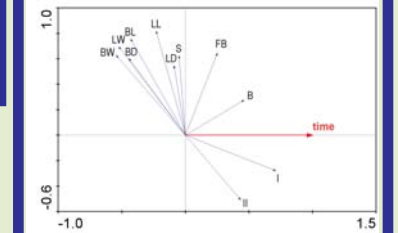


Fig. 4. RDA of population samples recorded at the beginning and the end of the flowering period in a locality in the Bohemian Forest. Explanatory character: time. Total variation explained by the first canonical axis 18.1 % (I - 50.7%, BW 29.7%, LW 27.6%, B 21.4%, DB 19.8%, II 19.0%, LB 18.6%, FB 6.4%, LL 5.3%, LD 0.8%, S 0.3%). Monte Carlo permutation test F=13.08, p<0.01.

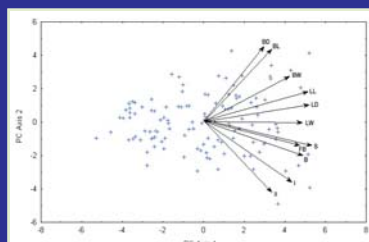


Fig. 6. PCA of population samples of *M. pratense*. The arrows indicate directions of increase of morphological characters.

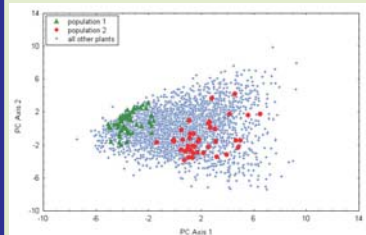


Fig. 7. Positions of individual plants in the ordination space of PCA of population samples. Two population examples are marked.

Results

- * The values of seasonal characters, which are counted as the most important ones, usually have considerably large variation in the same population. Values of characters in particular population samples may change over the flowering period

- The range of the number of internodes in one population is often between 5 and 7 internodes (Fig. 3).
- The average number of internodes in population sample can increase by two over the flowering period.
- Number of internodes and that of intercalary internodes and number of bracts and that of flowering bracts are often positively correlated with the flowering period, while the dimensions of leaves and bracts have often negative correlation (Fig. 4).

- * The variation of the most seasonal characters seems to be related to altitude. Character values have a large variation in the lowlands, while in the higher regions is their range restricted (examples in Fig. 5a, b).

- * The studied population samples constitute only one compact swarm in ordination diagram without possibility to see any separation (Fig. 6).

- All the studied characters are more or less correlated with the first ordination axis

- * The projection of individual plants in the ordination space (Fig. 7) confirms the homogeneity of studied plants from the global point of view. However, the "swarm" is composed from the discrete populations.

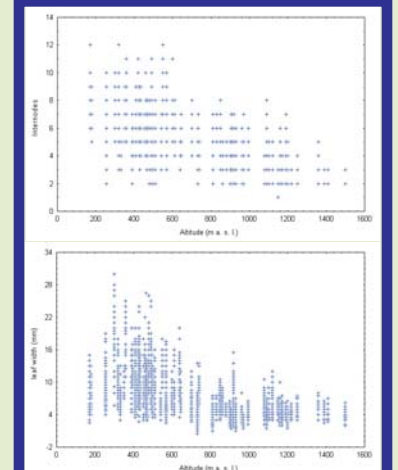


Fig. 5a, b. Changes of variation in the number of internodes and leaf width with altitude

Acknowledgements

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Conclusions

- 1) Studied population form a very homogeneous reticulate pattern. Delimitation of intraspecific taxa based on the seasonal characters is impossible and would be artificial.
- 2) Populations of *Melampyrum pratense* break up into diverse "regional types" over all the distribution area. These types are characterised by a specific combination of seasonal characters, but also by other characters (the most conspicuous one is the flower colour).
- 3) Taxonomic description of these "regional types" is not much important, but processes generating this variation are worth of further study.