

Some Chromosome Counts in the *Campanula rotundifolia* Complex

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Received October 15, 1964

Abstract — Chromosome numbers of three species of the *C. rotundifolia* complex were examined [*C. rotundifolia* L., *C. polymorpha* (WITASEK) PRAIN et al., *C. corcontica* ŠOUREK]. Of the nine samples of *C. rotundifolia* three were found to be tetraploids ($2n = 68$) and five were diploids ($2n = 34$). In one sample triploids ($2n = 51$) were recorded, *C. polymorpha* and *C. corcontica* are tetraploids with $2n = 68$.

Introduction

The cytology of the *Campanula rotundifolia* complex has recently been dealt with in a series of papers. Investigations by BÖCHER (1936, 1960, 1963), GUINOCHE (1942), HUBAC (1961), GADELLA (1962, 1963, 1964), PODLECH (1962) and PODLECH et DAMBOLDT (1964) have revealed a number of interesting features and have elucidated a great deal of the structure of the complex, but at the same time some new problems appeared. One particularly difficult problem concerns the geographical distribution of the diploids and tetraploids. As was pointed out by BÖCHER (1960), diploids ($2n = 34$) predominate in the Arctic regions, but are found both in the mountains and in the lowlands of Central Europe, too. Owing to the wide distribution of the complex, extensive investigations in different parts of Europe are necessary, to understand the detailed distribution and ecological preferences of diploids and tetraploids. The purpose of this preliminary account is to contribute a few counts from the territory of Czechoslovakia. Further studies are in progress.

The complex consists of a number of minor taxa of different range and value which are often difficult to distinguish from each other. Some of them have been given specific names and others may be considered geographical races or ecotypes but at the present time any taxonomic treatment must be regarded as provisional. Further experimental studies are highly desirable.

Material and methods

Cytological investigations have been made on root-tip mitoses in young seedlings raised from seeds collected from natural habitats (three hour's pre-treatment in a saturated solution of oxyquinoline, staining with Belling's aceto-carmin without any fixation; squash technique). In all but one population (no. r 64) analyses of morphological characters were carried out. Full results will be included in a study of the variational patterns of the complex. In this paper only details of particularly striking characters are given. Some of the material is being cultivated in the Alpine Garden of the ČSAV at Černolice, and other plants are in cultivation in the experimental grounds of the Botanical institute of the ČSAV at Průhonice.

Results

C. rotundifolia L. 1753

1. Prague-Podhoří: rocky slopes of the Tříkrálka in the valley of Vltava; phyllite; cca 240 m (no. r. 50). $2n = 34$.

A small population consisting of plants with hairy stems and with many small flowers. Flowering relatively late.

2. Central Bohemia: the hill Homole in the vicinity of Vrané nad Vltavou; phyllite; cca 300 m (no. r. 4). $2n = 68$.

A large population occurring on rocks and also on the heaths covering the summit of the hill. It seems to be morphologically very close to the population from Podhoří.

3. Eastern Slovakia: the summit of the hill Folkmarská skála SE of Gelnica; limestone; 918 m (no. r. 57). $2n = 34$.

This population can be referred to the cluster of extremely narrow-leaved varieties that are mostly treated as a *C. pinifolia* UECHT. This, however, appears to be a heterogeneous aggregate of local races which may have developed independently of each other. The plants occur exclusively in rock crevices; they do not spread to the adjacent steppe. They are characterized by thickened roots and by tall, branching, glabrous stems with many small flowers. Flowering very late.

4. Western Slovakia: ruins of the castle of Čachtice SW of Nové Mesto nad Váhom; cca 370 m (no. r. 61). $2n = 68$.

On the whole, this population resembles sample no. r. 57 but the stems are rough-haired in their basal parts. The plants are found both in the rocks and in the grassy slopes.

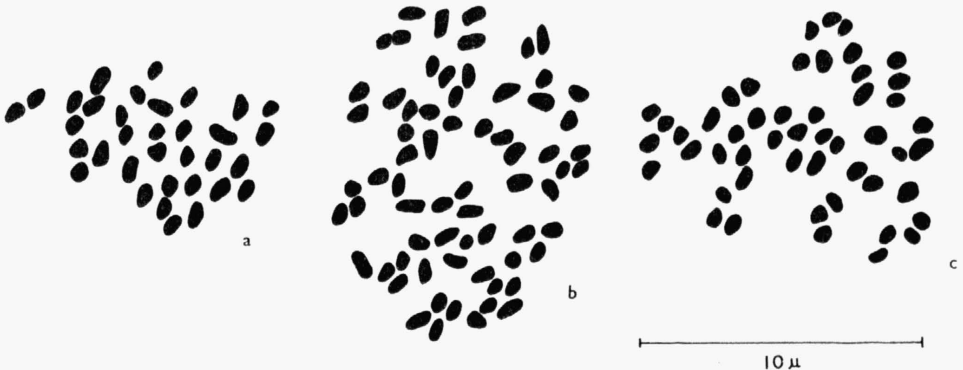


Fig. 1. — Root tip mitoses in *C. rotundifolia*, no. r. 66 (a — diploid, b — tetraploid, c — triploid plant)

5. Central Bohemia: the hill Paní hora near Bubovice (vicinity of Beroun); limestone; cca 410 m (no. r. 81). $2n = 34$.

A small community of narrow-leaved plants with hairy stems growing in a forest steppe.

6. Northern Bohemia: the hill Lovoš NW of Lovosice; basalt and phonolite; 400–500 m (no. r. 64). $2n = 34$.

A rather heterogeneous population occurring in a phonolitic scree, in a deciduous wood and in dry grass fields as well. Seeds were taken from the latter. The stems are from hairy to glabrescent. Flowering rather early.

7. NE Bohemia, the Krkonoše: rock crevices and scree in the Čertova rokle (the Devil's Gorge) near Pec pod Sněžkou; gneiss; 1100–1200 m (no. r. 66). $2n = 34, 51, 68$. (Fig. 1).

A montane population, composed of few-flowered plants with a low growth and ascending, hairy stems. In a sample of seeds collected at random from a number of individuals three different chromosome numbers were found. This is rather surprising, as the population does not appear to be more variable than others in which only a single number was found.

8. Northern Moravia, the Jeseníky: rock crevices in the Velká kotlina near Karlova Studánka; phyllitic gneiss; cca 1250 m (no. j. 4). $2n = 68$.

This montane population, found only on rocks, corresponds partly to what was described as a var. *sudetica* HRUBÝ. This, however, requires a careful taxonomic and nomenclatural revision. The population is rather close to that from the Čertova rokle but it is distinguishable by the

predominance of tubular flowers and by the larger capsules which are characters of *C. polymorpha*.
9. Central Bohemia: the hill Velkoveský vrch E of Kralupy nad Vltavou; augitite; 264 m (no. r 63). $2n = 34$.

A rather variable population, including both tall, multiflorous plants, and dwarf, single flowered individuals. The stems are pubescent in their lower parts; shape of flowers and length of sepals very variable.

C. polymorpha (WITASEK) PRAIN et al. 1913

Syn.: *C. polymorpha* WITASEK 1906 [pro subsp. *C. Kladniana* (SCHUR) WITASEK 1902]; *C. Kladniana* (SCHUR) WITASEK 1902 p. p.; *C. Scheuchzeri* SAG. et SCHN. 1891, non VILL. 1779.

1. Slovakia, the High Tatra: the valley Velická dolina; granite; cca 1800 m (no. p 11). $2n = 68$.
2. Slovakia, the High Tatra: slopes of the Ostrva at the lake Popradské pleso; granite; cca 1700 m (no. p 16). $2n = 68$.
3. Slovakia, the Low Tatra: below the summit of the Koňsko; granite; 1800 m (no. p 21). $2n = 68$. (Fig. 2d).

This interesting Carpathian counterpart of the Alpine *C. Scheuchzeri* VILL. differs from *C. rotundifolia* L. in having obtuse leaves, few flowered inflorescence, larger flowers, larger capsules and larger seeds. Its erect flower buds distinguish it from *C. Scheuchzeri* VILL. It seems to be an endemic of the



Fig. 2. — Root tip mitoses in *C. polymorpha*, no. p 21 (d) and in *C. corcontica*, no. c 2 (e). Scale as in fig. 1.

Western and Eastern Carpathians. Its occurrence in the Southern Carpathians, and its relationship to the rather obscure *C. Kladniana* (SCHUR) WITASEK, require further examination. In the Tatra it is common both on granite and on limestone above 1400 m. The highest altitude, at which this species was collected, was 2400 m. As is suggested by the name, it is extremely variable but its variability appears to be of no value from the taxonomic point of view. No data concerning the chromosome number are available.

The nomenclature presents some difficulties, as there is a validly published name *C. tatrae* BORBÁS which may refer to this taxon, too. If this is the case, the name *C. polymorpha* should be substituted by the latter.

C. corcontica ŠOUREK 1953

Syn.: *C. Scheuchzeri* auct. boh. et siles., non VILL. 1779; *C. Kladniana* (SCHUR) WITASEK 1902 p.p. ? *C. bohémica* Hruby 1930.

1. NE Bohemia, the Krkonoše: grass lands in the Obří důl in the vicinity of Pec pod Sněžkou; gneiss; cca 900 m (no. c 2). $2n = 68$. (Fig. 2e).

A rather sharply defined taxon with a peculiar combination of morphological characters: stems angular and tough-haired in the lower parts, leaves tough, lanceolate, congested at the base of the stem; inflorescence few-flowered, flower buds erect, corolla hemispherical at the base, sepals triangular. Geographically it is confined to the Krkonoše where it is rather frequent in grass lands from 900 to 1500 m. It never occurs in rock crevices. The species was mistaken for *C. Scheuchzeri* VILL. or even for *C. Kladniana* (SCHUR) WITASEK for years. As late as in 1930 it was described as a *C. bohémica* by HRUBY, but not very accurately, so that some doubts about the validity of the description appeared and the species was described de novo by ŠOUREK in 1953.

Discussion

Four of the populations of *C. rotundifolia* (no. r 50, r 63, r 64 and r 81) are shown to belong to the group of lowland diploids (BÖCHER 1960) which seem to be only scattered in Western, Central and Eastern Europe (cf. BÖCHER l. c., GUINOCHE 1942, GADELLA 1962, 1963, 1964). A diploid sample from the vicinity of Prague was mentioned by GADELLA (1963).

The narrow-leaved samples do not appear to be homogeneous from the cytological point of view. One of them (no. r 61) is tetraploid and two (r 81, r 57) are diploid. But whereas the no. r 81 only differs from the common *C. rotundifolia* in having narrow leaves, the latter (no. r 57) deviates considerably and by some characters it is referred rather to the series *Saxicolae* WITASEK. Its taxonomic position is now being studied.

A comparison of no. r 4 and no. r 50 is very interesting. Eventhough both the populations are clearly similar as regards the morphological characters (the size of stomata and of pollen grains has not yet been examined) and eventhough their ecology is essentially the same, there is a difference in the chromosome number. Both the localities belong to the same phytogeographical district (the valley of the lower Vltava) and are about 20 km distant from each other. The populations lack any connection at the present time. Both of them will be the subjects of a more detailed research.

The no. r 66 seems to be composed of plants of two cytotypes (diploids and tetraploids) and, as triploids are recorded amongst the seedlings, the two cytotypes appear to be hybridizing. In an original diploid population some tetraploid individual may have appeared which has considerably influenced the genetical structure of the population. Tetraploid plants may have arisen from diploids following temperature shocks during meiosis. It is possible that the diploid plants crossed with the tetraploid *C. corcontica* which occurs in a locality about 2 km away but this eventuality is not very likely, as the plants in no way resemble *C. corcontica* and the local conditions do not favour hybridisation with this species. Triploids are very rare within the complex. They have only been found in var. *pubescens* DC. from the Alpes Maritimes (GUINOCHE 1942) and in artificial hybrids of the tetraploid *C. rotundifolia* L. with the diploid *C. cochlearifolia* Lam. (BIELAWSKA 1964). Investigations of the offspring of some plants of the no. r 66 are in progress.

As was expected, both the montane races, *C. polymorpha* and *C. corcontica*, were shown to be tetraploids. These taxa have not previously been examined cytologically; SUGIURA (1942) and BÖCHER (1960) have, however, counted material of *C. Kladniana* (SCHUR) WITASEK ($2n = 68$), a taxon which may be referable to *C. polymorpha*.

Acknowledgements

The author is greatly indebted to Mr. J. Holub, C.Sc., for helpful suggestions, to Mrs. I. Novotná, C.Sc., for valuable technical assistance and to Mr. D. Briggs, Ph.D., for a critical revision of the text.

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