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Taxonomic and chorological study of the *Muscari botryoides* (L.) Mill. complex in Hungary

PhD thesis

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8. Summary

The taxonomic revision of *Muscari botryoides* (L.) Mill. (s. l.) complex in Hungary is presented. The aim of this research was to evaluate all characteristics used to be considered important or even differential among the taxa concerned in the literature.

Plant material was collected from 25 localities of Hungary as well as from Serbia (Valjevo, Petnica Science Center) and Romania (Sibiu-Guşteriţa: locus classicus of *M. transsilvanicum* Schur) in 1996–2002, then planted in experimental field in Budapest (Botanical Department of the Hungarian Natural History Museum). Morphometric analysis on full blooming plants was carried out in the experimental field in 1997 and 1998. The following characters were measured and tested with unpaired *t* test: the height of plant, the maximal width of leaves, the number of veins on the abaxial surface of the widest leaf. In order to evaluate the qualitative characteristics and to demonstrate the phenological changes of the pot-grown plants, they were documented by many photos. The karyotype structure and/or ploidy level of each sample were determined. In addition anatomical investigations and herbarium revisions (BP, DE) were also carried out. The results are as follows:

1) The protologues (LINNAEUS 1753, MILLER 1768, SCHUR 1853, 1856, MARCHESETTI 1882, PRISZTER 1972) of the *Muscari botryoides* (s. l.) complex in the Carpathian Basin do not clarify the morphological differences of the taxa under study [*M. botryoides* (L.) Mill., *M. transsilvanicum* Schur, *M. kerneri* Marchesetti, *M. botryoides* (L.) Mill. ssp. *hungaricum* Priszter].

2) Though there are some variable characters (e. g. the width of leaves) the *Muscari botryoides* complex is somewhat uniform morphologically. Traditional characters used to be considered as differential or important in the literature (leaves, inflorescence, flowers) are not suitable for unambiguous distinction of the taxa, so I have rejected the key of SOÓ (1973) and MÁJOVSKÝ et al. (1984).

3) Despite the morphological similarity two ploidy levels were ascertained in Hungarian, Romanian and Serbian populations. Beside the only former record (PÓLYA 1950) further diploid (2n = 18) and tetraploid (2n = 36) populations were registered in Hungary (25 localities). However diploid and tetraploid plants can not be distinguished on morphological base in the experimental garden (see GARBARI 1984) or in the field.

4) New chromosome number records in Hungary are as follows: Ásotthalom, Átokháza (2n = 18); Barcs, near a fish pond (2n = 36); Barcs, Antalpuszta (2n = 36); Dabas, Vizes-nyílás (2n = 18); Demjén, Hegyes-kőbérc (2n = 36); Felsőcsatár, Nagyvilágos-hegy (2n = 36); Felsőtárkány, Galya-tető (2n = 36); Izsák, near Kolon-tó (2n = 18); Jászfelsőszentgyörgy, Lucskos (2n = 18); Kerecsend, Berek-erdő (2n = 36); Kerecsend, Lógó-part (2n = 36); Keszthely, Pórak-háti-völgy (2n = 36); Keszthely, Tüskés (2n = 36); Lesencetomaj, Billegei-erdő (2n = 36); Mesztegnyő, Búsvári-tó (2n = 36); Nagykőrös, Nagy-erdő (2n = 18); Petőmihályfa, Öreg-hegy (2n = 36); Pécs, Dömörkapu (2n = 18); Pécsvárad, Arany-hegy (2n = 18); Szőce, near the fen (2n = 36); Veszprém, Alsó-erdő (2n = 18); Veszprém, Tekeres-völgy (2n = 18); Vértessomló, Zsemlyei-erdő (2n = 36); Villánykövesd, Fekete-hegy (2n = 18); Viszló, Nyirjes-erdő (2n = 36).

5) New chromosome number records outside Hungary are as follows: Sibiu-Guşteriţa, Romania (the locus classicus of *M. transsilvanicum* Schur): 2n = 18; Valjevo (Petnica Science Center), Serbia: 2n = 18.

6) The karyotypes of almost all (perhaps excl. 2) diploid populations are extremely similar: 2 pairs of long acrocentric (on one of them usually with satellites) + 3 pairs of medium-sized submetacentric–metacentric + 4 pairs of short ±metacentric chromosomes. The populations at Ásotthalom (Hungary) and Valjevo (Serbia) need further study.

7) The tetraploid karyotype seems to be somewhat duplication of the diploid one: 4 pairs of long acrocentric (on 2 of them usually with satellites) + 6 pairs of medium-sized submetacentric–metacentric + 8 pairs of short ±metacentric chromosomes. Further study is needed to clarify the genetic relationship of the diploid and tetraploid cytotypes in Hungary.

8) Since *Hyacinthus botryoides* was described from Italy (LINNAEUS 1753) where only tetraploid populations are known (GARBARI 1966, 1984), it is obvious that *M. botryoides* (L.) Mill. (s. str.) is a tetraploid species. Moreover the karyotype of *M. botryoides* (L.) Mill. fundamentally corresponds to that of *M. botryoides* ssp. *longifolium* published in FRATTINI et al. (1996), which is extremely similar to those of the Hungarian tetraploid populations. Therefore – contrary to the former assumptions (SOÓ 1964, 1972, 1973, SOÓ & KÁRPÁTI 1968, SIMON 1992, 2000) – *M. botryoides* (L.) Mill. (ssp. *botryoides* sensu auct. hung.) is also native to Hungary.

9) Almost all diploid populations under study (perhaps excl. 2; see 6.) correspond to *M. transsilvanicum* Schur. This treatment is based also on the chromosome number and karyotype but not on Schur’s description.

10) The diploid populations in the Mecsek Mts and Villány Mts can be distinguished from that of the locus classicus of *M. transsilvanicum* neither by morphological nor cytological characters. Consequently there is no reason to support the taxon *M. botryoides* (L.) Mill. ssp. *hungaricum* Priszter since it does not differ from the sample collected at Sibiu-Guşteriţa in any of the characteristics mentioned in its protologue. In this respect I meet the views of MÁJOVSKÝ et al. (1984) and SPETA (1994).

11) There is no proof for the presence of *M. kerneri* Marchesetti in Hungary which is moreover a dubious taxon, since its segregation from *M. transsilvanicum* is not evident at all (SPETA 1994).

12) The leaves of *M. botryoides* are wider than those of *M. transsilvanicum* but this distinction can be recognized only by mathematical statistical methods. In this respect Schur’s description is really erroneous as

was pointed out by MÁJOVSKÝ et al. (1984). The length of leaves and the intactness of the leaves' tips proved to be highly influenced by the occasional hibernation of the leaves.

13) The compactness of the inflorescence – which was emphasized by PRISZTER (1972) as a distinctive character of ssp. *hungaricum* in contrast to ssp. *botryoides* and ssp. *transsilvanicum* – absolutely depends on the phenological state of the plant independently of the ploidy level: at the beginning of anthesis (i.e. when the lowest flowers bloom) the racemes are compact, later they become gradually looser. Contrary to PRISZTER (1972) the inflorescences of *M. botryoides* and *M. transsilvanicum* are not compact in full bloom, although if the weather is adverse the inflorescences may remain more or less compact.

14) The properties of the flowers (colour, size) used to be considered as important characters in e. g. ASCHERSON & GRAEBNER (1905), SOÓ (1973) and MÁJOVSKÝ et al. (1984) are not suitable for distinction of the taxa under study.

15) Further characters rarely mentioned in the literature (the height of the plant, the ability to produce offsets, the epidermal structure of the adaxial surface of leaves, the surface of the flowers and seeds) proved to be useless to distinguish *M. botryoides* and *M. transsilvanicum*.

16) The pattern of distribution of *M. transsilvanicum* and *M. botryoides* in Hungary is extremely remarkable. *M. transsilvanicum* is a south-eastern element with continental character, and is restricted almost exclusively to the Eupannonian Region (proposed by PÓCS 1981) where the continental character of the climate is enhanced. The only exceptions are the Mecsek Mts and Villány Mts in South Hungary (which territory used to be classed into Praeillyricum by Hungarian botanists) and the localities near the NE part of Lake Balaton which are close to the border of the Eupannonian Region. On the contrary *M. botryoides* is an atlantic-Mediterranean species, which does not occur in the Eupannonicum, i. e. the lowlands: it inhabits the subatlantic hilly W and SW part of Hungary and – apart from the unique locality in the Vértes Mts – the Northern Mountain Range and its close foreground (Kerecsend). The latter territory including the Slovak localities (MÁJOVSKÝ et al. 1984) seems to be the most eastern extension of the area of *M. botryoides*. The distribution pattern of *M. botryoides* is somewhat similar to that of *Scilla drunensis* Speta in Hungary (KERESZTY et al. 1986).

17) The supposed eastern–southeastern vs. western–southwestern pattern of the areas of diploids and tetraploids are mostly confirmed by former

European records (PÓLYA 1950, LÖVE & LÖVE 1961, GARBARI 1966, 1968, 1970, 1984, ŠOPOVA et al. 1983, KARLÉN 1984, MÁJOVSKÝ et al. 1984, SVESHNIKOVA & KRICSFALUSY 1985, POPOVA 1989, STECK-BLASER 1992, KRICSFALUSY 1999, DASHKO-SHPRYNGVALD 2000) although there are some data based on material of unknown or dubious origin. Conspicuous records (e.g. SATÔ 1943) may refer to other taxa or need confirmation (KARLÉN 1984). In my concept the pattern outlined above is valid on the European scale, and the frontier between diploids and tetraploids lies partly in the Carpathian Basin (the supposed frontier in the western part of the Balkan Peninsula is not known yet).

18) In my opinion the presence of *M. transsilvanicum* or *M. botryoides* in a region depends primarily on the pattern of European chorology, and only secondarily on plant community factors. Former records of ssp. *kerneri* in the Great Hungarian Plain (e. g. BORHIDI 1999a) as well as those of "*M. botryoides*" in the Mecsek Mts and Villány Mts (e. g. BORHIDI 1999b) refer to *M. transsilvanicum*.

19) The taxonomic problems of *M. botryoides* species complex raise some theoretical questions concerning the applicability of nomenclatural categories (species, subspecies).

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