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Nomenclatural adjustments for hybrids of the former *Inula* L. within *Pentanema* Cass. (Asteraceae)

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Abstract: Drastic recircumscription of *Pentanema* (Asteraceae) has resulted in transfers of many species from *Inula*, whereas hybrids with binomials have not received new combinations yet. However, names for interspecific hybrids of *Inula* auct. are in active current use, and a dozen nothospecies are regularly mentioned in floras, checklists, and research papers. I have facilitated 12 new combinations for nothospecies in *Pentanema*: *P.* ×*adriaticum* (Borbás) Seregin (*P. hirtum* × *P. spiraeifolium*), *P.* ×*haussmannii* (Huter) Seregin (*P. ensifolium* × *P. hirtum*), *P.* ×*hispidum* (Schur) Seregin (*P. asperum* × *P. hirtum*), *P.* ×*hybridum* (Baumg.) Seregin (*P. ensifolium* × *P. germanicum*), *P.* ×*litorale* (Borbás) Seregin (*P. ensifolium* × *P. spiraeifolium*), *P.* ×*mucheri* (Starm.) Seregin (*P. salicinum* × *P. squarrosum*), *P.* ×*savii* (Beck) Seregin (*P. salicinum* × *P. spiraeifolium*), *P.* ×*semiamplexicaule* (Reut.) Seregin (*P. helveticum* × *P. salicinum*), *P.* ×*strictum* (Tausch) Seregin (*P. ensifolium* × *P. salicinum*), *P.* ×*suaveolens* (Jacq.) Seregin (*P. oculus-christi* × *P. squarrosum*), *P.* ×*transsilvanicum* (Schur) Seregin (*P. asperum* × *P. germanicum*), *P.* ×*vrabelyianum* (Kern.) Seregin (*P. asperum* × *P. ensifolium*). A lectotype is designated for *Inula* ×*hausmannii* Huter in place of the superseded neotype published in 2019. Examples of current use are given for each hybrid. Availability of the new names will certainly be helpful for wider use and acceptance of *Pentanema*.

Key words: Inuleae, nomenclature, new combinations, Europe

1. Introduction

Molecular studies have shown the need for the transfer of most European *Inula* L. (Asteraceae) to the recircumscribed *Pentanema* Cass. (Gutiérrez-Larruscain et al., 2018). The philosophy of the "International Code of Nomenclature for algae, fungi, and plants" (Turland et al., 2018) is a reasonable balance between the principle of priority (Principle III) and stability of nomenclature (Art. 14.2). As always in such cases of radical redrawing of the plant genera, the authors of the latter study had two options following the Code: (1) to leave a few species in the type section of the well-known *Inula*, with a consequent transfer of dozens of widespread species into unwonted genera, or (2) to offer conservation of the genus *Inula* on a new type. The authors chose the first path, and the vast majority of *Inula* species received names in *Pentanema* (Gutiérrez-Larruscain et al., 2018). Boyko et al. (2018) and Gutiérrez-Larruscain et al. (2019) then published a small number of additional combinations.

Drastic recircumscription of *Pentanema* has resulted in transfers of species, whereas hybrids with binomials did not receive new combinations. The only exception was *P.* ×*medium* (M.Bieb.) G.V.Boiko & Korniy. (Boyko et al., 2018). However, names for interspecific hybrids of *Inula* are in active current use, and at least 10 nothospecies are being regularly mentioned in floras, checklists, and research papers. These hybrids are widely distributed throughout Central and Eastern Europe. Some other binomials for hybrids have been proposed, but they are either poorly recognized in the field or rare, or were proved to be synonyms.

There is a practical need in binomials for hybrids to curate the herbarium collections and biodiversity data within large databases. The aim of this short communication is rather straightforward: to make the binomials for nothospecies available in *Pentanema* in line with the preparation of the "Atlas of the Russian Flora" and for curation of the Moscow Digital Herbarium. Availability of the new names will certainly be helpful for wider use and acceptance of *Pentanema*.

2. Materials and methods

The nomenclatural treatment follows the Code (Turland et al., 2018). All cited basionyms were checked against protologues. I reported all existing discrepancies between protologues of basionyms and IPNI records to the curators

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of the International Plant Names Index (IPNI) for further proper indexing. Page citations of the protologues are hyperlinked with electronic libraries like BHL (https://www.biodiversitylibrary.org/) and Google Books (https://books.google.com/) to provide fast tracking of the original publications. Searching and study of the type specimens were beyond the scope of this communication. References published since the 1990s support the names in current use. The local floristic studies of that sort show where the researchers have recently recorded these nothospecies in the field, including notes on abundance and ecology. Parental species are given in alphabetic order in hybrid formulas due to lack of data on sex of parents for type specimens.

3. Results and discussion

Most often, *P. salicinum* (L.) D.Gut.Larr. et al. (and a closely related species *P. asperum* (Poir.) G.V.Boiko & Korniy.), *P. ensifolium* (L.) D.Gut.Larr. et al., *P. spiraeifolium* (L.) D.Gut.Larr. et al., *P. squarrosum* (L.) D.Gut.Larr. et al. (= *P. conyzae* (Griess.) D.Gut.Larr. et al.), *P. hirtum* (L.) D.Gut.Larr. et al., *P. germanicum* (L.) D.Gut.Larr. et al., *P. oculus-christi* (L.) D.Gut.Larr. et al., and *P. britannicum* (L.) D.Gut.Larr. et al. take part in the formation of hybrid complexes, whereas *P. bifrons* (L.) D.Gut.Larr. et al., *P. caspicum* (F.K.Blum ex Ledeb.) G.V.Boiko et al., and *P. helveticum* (Weber) D.Gut.Larr. et al. were mentioned as hybrid parents just once. Assumed hybrids of *P. helenioides* (DC.) D.Gut.Larr. et al. and *P. montanum* (L.) D.Gut.Larr. et al. were synonymized earlier (Gutiérrez-Larruscain et al., 2019).

3.1. Names in current use

***Pentanema* ×*semiamplexicaule* (Reut.) Seregin, comb. nov.** (*P. helveticum* × *P. salicinum*). Basionym: *Inula* ×*semiamplexicaulis* Reut., Mém. Soc. Phys. Genève 7: 169. 1836. – The hybrid was recognized in Switzerland and France by Müller (1996), Advocat et al. (2005), and Verlaque and Reduron (in Marhold, 2008). The latter study reported the chromosome number (*2n* = 16).

***Pentanema* ×*savii* (Beck) Seregin, comb. nov.** (*P. salicinum* × *P. spiraeifolium*). Basionym: *Inula* ×*savii* Beck, Denkschr. Kaiserl. Akad. Wiss., Wien. Math.-Naturwiss. Kl. 44: 306. 1882. – The nothospecies was recognized by Starmühler (2005) and reported for Italy from Monte Spaccato in the Triest area.

***Pentanema* ×*adriaticum* (Borbás) Seregin, comb. nov.** (*P. hirtum* × *P. spiraeifolium*). Basionym: *Inula* ×*adriatica* Borbás, Mathematikai és Természettudományi Közlemények, 14: tab. 1. 1877 (February); Oesterr. Bot. Z. 27: 187. 1877 (June). ≡ *Inula* ×*semiamplexicaulis* var. *adriatica* (Borbás) Vis., Fl. Dalmat. Suppl. 2: 503. 1877. – The nothospecies was recently recorded in Slovenia by Starmühler (2005) and in Croatia by Rottensteiner (2012). Tison (2014) mentioned *P. hirtum* × *P. spiraeifolium* hybrid without binomial from southern France as rare.

***Pentanema* ×*litorale* (Borbás) Seregin, comb. nov.** (*P. ensifolium* × *P. spiraeifolium*). Basionym: *Inula* ×*litoralis* Borbás, Értekezések a természettudományok köréből, 9/15: 6. 1879; [cf. Beck, Denkschr. Akad. Wien, Math. Nat. 44: 311. 1882]. ≡ *Helenium* ×*litorale* (Borbás) Kuntze, Revis. Gen. Pl. 1: 343 (1891). – The hybrid was recently reported from Hungary by Dénes (2000) and Dénes et al. (2010), and listed for Istria in the checklist by Starmühler (2005).

***Pentanema* ×*hybridum* (Baumg.) Seregin, comb. nov.** (*P. ensifolium* × *P. germanicum*). Basionym: *Inula* ×*hybrida* Baumg., Enum. Stirp. Transsilv. 3: 132. 1817. – One of the most common *Pentanema* hybrids, which was reported recently for the Czech Republic (Hrouda, 2004), European Russia (Gubanov, 1994), Istria (Starmühler, 2005), Romania (Drăgulescu, 2010), and the Crimea (Mironova and Fateryga, 2015). There are quite a few records from Hungary as well (Kun, 1996; Bőhm, 2001; Somlyay and Pifko, 2002, etc.).

***Pentanema* ×*strictum* (Tausch) Seregin, comb. nov.** (*P. ensifolium* × *P. salicinum*). Basionym: *Inula* ×*stricta* Tausch, Syll. Pl. Nov. 2: 253. 1828. ≡ *Helenium* ×*strictum* (Tausch) Kuntze, Revis. Gen. Pl. 1: 343 (1891). = *Inula* ×*neilreichii* A.Kern., Sched. Fl. Exsicc. 1: 91. 1881. – The hybrid was recently reported from Austria by Melzer and Barta (1995), Hungary by Molnár (2001), Istria by Starmühler (2005), and Romania by Oprea and Sîrbu (2005). The nothospecies is apparently not rare in the Czech Republic, with multiple new records (Chytrý, 1997; Hrouda, 2004; Danihelka et al., 2008; Tichý, 2015); Somlyay and Pifko (2002) consider it to be the most common hybrid of the genus in Hungary.

***Pentanema* ×*suaveolens* (Jacq.) Seregin, comb. nov.** (*P. oculus-christi* × *P. squarrosum*). Basionym: *Inula suaveolens* Jacq., Hort. Vindob. 3: 29, t. 51 (1776). – The hybrid was described using cultivated plants and later discovered in the wild. Recently Hrouda (2004) and Starmühler (2005) recorded this nothospecies from the Czech Republic and Istria, respectively. *Inula* ×*intermixta* Jos.Kern., Oesterr. Bot. Z. 25: 382. 1875 refers to this name as well, although Kerner was clearly against the implementation of Jacquin's name for this hybrid.

***Pentanema* ×*haussmannii* (Huter) Seregin, comb. nov.** (*P. ensifolium* × *P. hirtum*). Basionym: *Inula* ×*haussmannii* Huter, Oesterr. Bot. Z. 13: 137. 1863. – The hybrid was recently reported by Hrouda (2004) from the Czech Republic, and listed by Starmühler (2005) for Istria.

Lectotype (designated here): "*Inula hausmanni* Huter in Botanisch. Wochenblatt 1863. *Inula hirta – ensifolia* Hausmann. Von Huter (Rupert) 1862 inter *Inulam hirtam* et *ensifoliam* detecta. Aber auch manchmal weit

von den benanten entfernt. [*Illegible word*] am Tombea und Cingolo rosso" (W-Rchb. 1889-0045026) [preserved in W Herbarium]. – The neotype designated earlier by Gutiérrez-Larruscain et al. (2019) should be superseded following Article 9.19a of the Code, because the original material was found to exist. Moreover, an unlucky neotype was identified by Gutiérrez-Larruscain et al. (2019) as *Pentanema ensifolium*, whereas the lectotype clearly shows intermediate features in the shape of the leaves and general habit.

***Pentanema* ×*mucheri* (Starm.) Seregin, comb. nov.** (*P. salicinum* × *P. squarrosum*). Basionym: *Inula* ×*mucheri* Starm., Carinthia II 195/115(2): 523. 2005. – The nothospecies was described by Starmühler (2005) from Krk Island in Croatia. *Inula adenophylla* Sennen & Pau described from Spain was supposed to be a hybrid of the same parentage (Pau, 1907), but proved to be conspecific with *Pentanema langeanum* after neotypification (Gutiérrez-Larruscain et al., 2019).

3.2. Hybrids with *Pentanema asperum*

Pentanema asperum is a species closely related to *P. salicinum*, and is generally neglected (Gutiérrez-Larruscain et al., 2018). When accepted, it is regarded as a subspecies of the latter species (Gubanov, 1994), a variety following Beck (1882), or as a distinct species (Boiko et al., 2018). Therefore, hybrids with *P. asperum* are usually treated under nothospecies formed by *P. salicinum*. In European Russia, *P. asperum* and *P. salicinum* are distinct and grow near each other only in some places (Seregin, 2015). Therefore, I am making 3 names available in *Pentanema* for hybrids with *P. asperum*.

***Pentanema* ×*transsilvanicum* (Schur) Seregin, comb. nov.** (*P. asperum* × *P. germanicum*). Basionym: *Inula* ×*transsilvanica* Schur, Enum. Pl. Transsilv.: 312. 1866.

***Pentanema* ×*hispidum* (Schur) Seregin, comb. nov.** (*P. asperum* × *P. hirtum*). Basionym: *Inula bubonium* var. *hispida* Schur, Enum. Pl. Transsilv.: 314. 1866. ≡ *Helenium* ×*hispidum* (Schur) Kuntze, Revis. Gen. Pl. 1: 343 (1891). –This name could also serve as a priority name for the hybrids *P. hirtum* × *P. salicinum* s.l. as *Inula rigida* Döll, 1862, widely used for these plants, is a later homonym of *Inula rigida* Vill., 1779. At the moment, there are no available names in *Inula* for the hybrids *P. hirtum* × *P. salicinum* s.str.

***Pentanema* ×*vrabelyianum* (Kern.) Seregin, comb. nov.** (*P. asperum* × *P. ensifolium*). Basionym: *Inula* ×*vrabelyiana* Kern., Oesterr. Bot. Z. 21: 59. 1871. ≡ *Helenium* ×*vrabelyianum* (Kern.) Kuntze, Revis. Gen. Pl. 1: 343 (1891). – The name has been used currently by Dénes (2000) for plants from Hungary. The use of this name in Sweden goes back to the paper by Lindman (1910), with superb illustrations of leaves. He used this name for *Pentanema ensifolium* × *P. salicinum* s.str. hybrids; therefore, the correct name for Swedish plants is *P.* ×*strictum*.

3.3. Hybrids without binomials

There are some other reliable field records of *Pentanema* hybrids, but no binomials have been provided for them. Gubanov (1994) reported putative hybrids *P. britannicum* × *P. caspicum* from European Russia. Hrouda (2004) recorded *P. britannicum* × *P. oculus-christi* from a single locality in the Czech Republic. Tison (2014) reported *P. bifrons* × *P. squarrosum* from southern France. I have not studied any specimens to either confirm the parentage of the abovementioned hybrids or to describe them as new nothospecies.

Surprisingly, Starmühler (2005) listed *P. britannica* × *P. salicina* hybrids for Istria. Parental species are widespread across Europe and Siberia, but have never been reported to give crosses. Although this formula was supposed for *Inula turolensis* Pau, the latter species proved to be conspecific with *Pentanema helenioides* after neotypification (Gutiérrez-Larruscain et al., 2019).

3.4. Problematic names

There are some other binomials for hybrids of the former *Inula*, but they were synonymized with the parental species in previous publications. For earlier names, a monograph by Beck (1882) is still a wonderful and complete reference.

Greuter regarded *Inula* ×*gutierrezii* Pau and *I.* ×*sennenii* Pau as synonyms of *I. langeana* Beck (≡ *Pentanema langeanum*)[11]. Later, Gutiérrez-Larruscain et al. (2019) transferred *I.* ×*adenophylla* Sennen & Pau into the synonymy of *Pentanema langeanum*, whereas *I.* ×*eliasii* Sennen & Pau, *I.* ×*stenophylla* Sennen & Pau, and *I.* ×*turolensis* Pau were synonymized with *Pentanema helenioides*.

Inula ×*setigera* Beck (*I. bifrons* × *I. thapsoides*) was described upon cultivated specimens (Beck, 1882) and not found later in the wild. Another taxon, *I.* ×*portenschlagii* Beck (*I. candida* × *I. conyzae*), is a dubious name of unknown origin and disputable parentage. In the protologue, Beck (1882) described it apparently from Sicily, but only *P. montanum* and *P. squarrosum* were reported from the island (Giardina et al., 2007).

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