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**An Asterotrichous, Hexaploid *Onosma* from Bulgaria:
O. malkarmayorum spec. nova (Boraginaceae-
Lithospermeae)**

By

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With 15 Figures

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Key words: *Boraginaceae*, *Lithospermeae*, *Onosma malkarmayorum* spec. nova. – Chromosome numbers, hypoploidy, karyology, morphology, systematics, taxonomy. – Flora of Bulgaria.

Summary

TEPPNER H. 2008. An asterotrichous, hexaploid *Onosma* from Bulgaria: *O. malkarmayorum* spec. nova (Boraginaceae-Lithospermeae). – *Phyton* (Horn, Austria) 48(1): 117 – 132, with 15 figures.

Onosma malkarmayorum TEPPNER, spec. nova, is a low suffrutex with well developed sterile shoots at flowering time. The asterotrichous indumentum usually is strongly appressed on the very narrow basal leaves and more or less obliquely patent otherwise. Upper stem leaves are dilated near the base, bracts are relatively long, the calyx is c. half as long as the corolla, the latter appears dark yellow. The plant occurs in the West Rhodope Mountains. The chromosome number is $2n = 38$, which can be interpreted as hypohexaploid in relation to the basic chromosome number of $x = 7$, usually found in asterotrichous species. Potential parents may be *O. stjoanoffii* (TURRILL) TEPPNER ($2n = 14$), the most similar species, and a tetraploid type of *O. heterophylla* GRISEB. ($2n = 26$).

Zusammenfassung

TEPPNER H. 2008. An asterotrichous, hexaploid *Onosma* from Bulgaria: *O. malkarmayorum* spec. nova (Boraginaceae-Lithospermeae). [Eine asterotriche, hexaploide *Onosma* aus Bulgarien: *O. malkarmayorum* spec. nova (Boraginaceae-Lithospermeae)]. – *Phyton* (Horn, Austria) 48(1): 117 – 132, mit 15 Abbildungen.

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Onosma malkarmayorum TEPPNER, spec. nova, ist ein niederer Halbstrauch mit zur Blütezeit gut entwickelten sterilen Trieben. Das asterotriche Indumentum ist auf den sehr schmalen Grundblättern meist stark angedrückt, sonst mehr oder weniger stark schräg abstehend. Die oberen Stengelblätter sind nahe der Basis verbreitert, die Tragblätter der Blüten sind relativ lang, der Kelch ist ca. halb so lang wie die Krone, die dunkelgelbe Farbe hat. Die neue Art kommt in den West-Rhodopen vor. Die Chromosomenzahl beträgt $2n = 38$ und kann als hypohexaploid interpretiert werden (in Relation zu der bei asterotrichen Onosmen üblichen Chromosomenrundzahl von $x = 7$). Als potentielle Ausgangssippen kommen *O. stojanoffii* (TURRILL) TEPPNER ($2n = 14$), die ähnlichste Art, und ein tetraploider *O. heterophylla* GRISEB.-Typ ($2n = 26$) in Frage.

1. Introduction

In the course of karyological studies on Balcanic *Onosmas* in 1980/82, one population in the W. Rhodope Mts with an unusual chromosome number has been detected. It seemed possible that it could be a new species. Due to the strongly urgent work on the Greek species (TEPPNER 1991a) and other obligations this problem was forced back. New efforts of colleagues and myself finally, allowed to describe this taxon to science.

2. Material and Methods

Herbarium material from few localities, field fixations from three stations and root tips from a cultivated population were available.

Descriptions of the indumentum refer always to the upper side of the leaf blade, if not otherwise indicated.

The material for the karyological investigations (flower buds, root tips) was gained in the field and from plants cultivated in the Botanic Garden at the Institut fuer Pflanzenwissenschaften der Universitaet Graz, respectively. Fixations were made in ethanol : chloroform : glacial acetic acid 5 : 3 : 1 and the material was stained in acetic acid carmine in the usual way for squash preparations; root tips were pre-treated with an 8-hydroxyquinoline solution (e. g., DARLINGTON & LA COUR 1963, SHARMA & SHARMA 1965).

LM investigations were made with a Zeiss Photomikroskop III (with a camera lucida) and for herbarium material a Wild M38 stereomicroscope was used.

3. *Onosma malkarmayorum* TEPPNER, spec. nova

Diagnosis: Perennis, basi suffrutescens, caules steriles breves vel elongati, laxe dispositos. Folia ramulorum steriliu angusta, c. 3–9 cm longa et 1–5 mm lata, anguste obovata, revoluta, indumento e setis tuberculo stellato-piloso insidentibus densissime obtecta. Caules floriferi erecti vel basi adscendentes, bifurcati vel tripartiti. Flores breve pedicellati. Calyx floris 10–14 mm longus, setis tuberculo stellato-piloso. Corolla 20–25 mm longa, perflava, pubescens. Antherae 6.5–8.2 mm longae, basi connexae. Nuculae 2.3–3.3 mm longae.

Chromosomatum numerus: $n = 19$, $2n = 38$.



Fig. 1. Habitat of *Onosma malkarmayorum* at the type locality near Grohotno, 16. 5. 2008, phot. H. MAYRHOFER.

Holotypus: Bulgarien, Westliches Rhodope-Gebirge, Smolian District, Divin Municipality, ca. 200 m S von Grohotno, an der Straße nach Teshel, ca. 830 m, $41^{\circ} 41,384' N / 24^{\circ} 22,160' E$; ostexponierte Straßenböschung; 16. 5. 2008; leg. H. MAYRHOFER (SOM). – Isotypus: GZU.

Icones: h. l. Fig. 1–11.

Habitatio: Montes Rhodope Occidentales (inter flumina Nestos et Arda).

Eponymy: In honour of the three biologists, whose collections served as the base of this paper (the first three letters of the name, each):

Univ.-Prof. Dr. Hans MALICKY (Lunz am See, Lower Austria)

Prof. Mag. Rainer KARL (Köflach, Styria)

Ao. Univ.-Prof. Mag. Dr. Helmut MAYRHOFER (Graz, Styria).



Fig. 2. *Onosma malkarmayorum*, a plant at the type locality near Grohotno, at the begin of anthesis, 16. 5. 2008, phot. H. MAYRHOFER.



Fig. 3. *Onosma malkarmayorum*, detail of the plant in Fig. 2, phot. H. MAYRHOFER.



Fig. 4. *Onosma malkarmayorum*, Vucha valley S. of Krichim, 16. 5. 2008, phot. H. MAYRHOFER.

Description: A laxly caespitose subshrub (suffrutex), usually with a number of sterile shoots at flowering time (Fig. 3, 4, 5, 7 and 9). Sterile shoots short to moderately elongated, 1–2 to c. 12–15 cm long, with leaves crowded rosette-like on the top, leaves c. 3–9 cm long, very narrow to narrow obovate, c. 1.0–5.0 mm wide, revolute, with a long petiole-like part, ca. $\frac{1}{3}$ to $\frac{1}{2}$ of the total leaf length. Indumentum (Fig. 10 and 11) usually strongly appressed [except for the margin of the petiole-like part with up to 2.5–3.5 (–4.0) mm long, patent setae], tubercles different in size, the larger ones with ca. (4–)8–15(–20), the smaller ones with 2–9 rays, few scattered, short, simple hairs along the midvein (Fig. 11), tubercles dense, rays usually strongly intermingling, appearance of leaves greyish. Rosette of the sterile shoots in the spring (of the second year, usually) producing a terminal inflorescence and new lateral, sterile shoots.

Inflorescences erect or a little ascendent basally, c. 14–20 cm high, in fruit up to 30 to nearly 40 cm, apically with a double-cincinnus (boragoid), sometimes with a third cincinnus (paracladium) in the uppermost leaf axil (Fig. 5, 7 and 9). Stem leaves c. 3–5(–7) cm long, usually persistent in the lower third of the stem at flowering time, lower stem leaves more or less similar to the basal ones, narrow obovate usually, shape changing to \pm linear or linear-lanceolate below the middle of the stem, then increasingly narrow ovate, the upper ones widest near the base up to 7–11 mm and abruptly narrowed here, but not subcordate, gradually narrowing towards the tip and thus \pm acute. Indumentum often more patent and with fewer



Fig. 5. *Onosma malkarmayorum* from Grohotno, at the begin of anthesis, 16. 5. 2008, leg. H. MAYRHOFER; holotype (SOM).



Fig. 6. *Onosma malkarmayorum* from Grohotno, 16. 5. 2008, leg. H. MAYRHOFER, inflorescence; isotype (GZU).



Fig. 7. *Onosma malkarmayorum* from the Vucha valley S of Krichim, plant in the middle of anthesis, 16. 5. 2008, leg. H. MAYRHOFER (GZU).



Fig. 8. *Onosma malkarmayorum*, inflorescence, detail of Fig. 7.

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Fig. 9. *Onosma malkarmayorum* from the surroundings of Beden, 2. 6. 2007, leg. R. KARL (GZU).

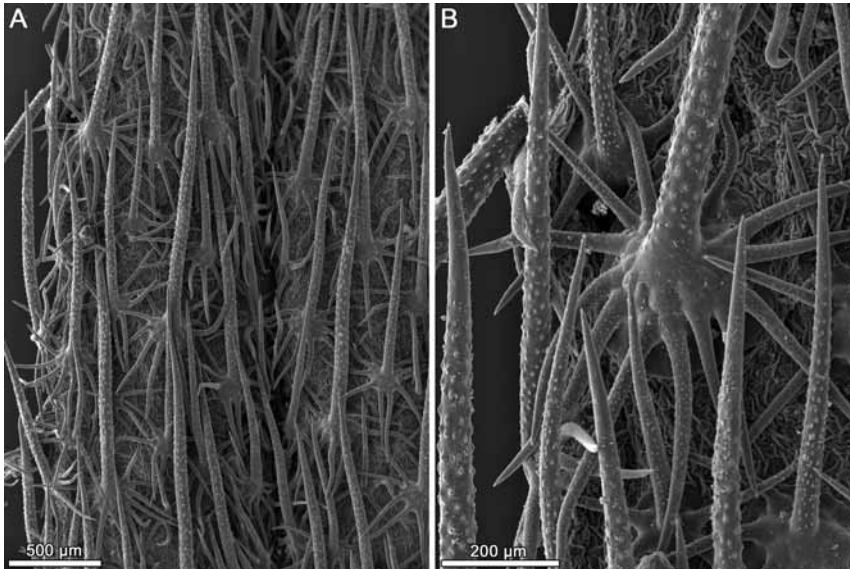


Fig. 10. *Onosma malkarmayorum*, SEM image of the indumentum of the upper side of a leaf of a sterile shoot, from a dry herbarium specimen, from Grohotno (isotype). In A midvein right from the middle. B: detail from the leaf margin in A. – Phot. E. STABENTHEINER.

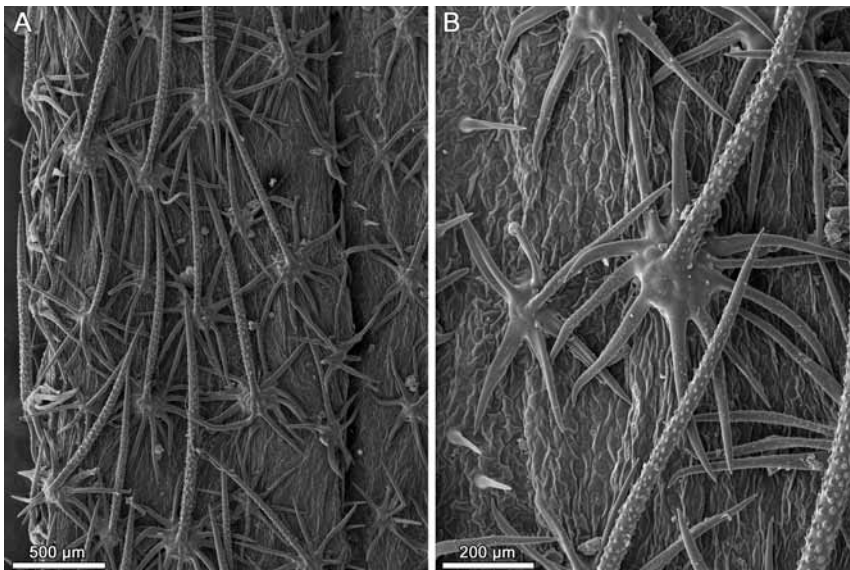


Fig. 11. *Onosma malkarmayorum*, SEM image of the indumentum of the upper side of a leaf of a sterile shoot, from a dry herbarium specimen, from Beden. In A midvein in the right part of the figure. B: detail from A along the midvein. – Phot. E. STABENTHEINER.



Fig. 12. *Onosma malkarmayorum*, two mitotic metaphase plates from root tips, with $2n = 38$ chromosomes, material from Beden. Cult. no BOR 1206.

rays per tubercle, otherwise similar to that of the leaves of the sterile shoots. Cincinni with (5–)8–18 flowers, lower internodes up to 8–4 mm, elongated in fruit up to 20–5 mm. Bracts of the lowermost 2–5 flowers as long as calyx plus pedicel or a little longer, then diminishing, the uppermost ones shorter (half as long or a little more) as the calyx. Lowermost bracts enlarged near the base, up to 4–8 mm, abruptly narrowed, rarely subcordate. Indumentum less dense and with fewer rays than in basal leaves, often a part of the tubercles without rays.

Flowers (Fig. 3, 6 and 8) shortly pedicellate to sessile, on thick, stiff pedicels, (10.0–)5.0–1.0 mm long. Calyx (9–)10–14 mm, c. half or more than half of the corolla length, little enlarged in fruit (up to 17.5–15 mm), sepals narrowly lanceolate, 0.7–1.4 mm wide, up to 1.3–1.5(–2.0) mm in fruit, outside covered with oblique patent, asterotrichous hairs on large and small tubercles, the larger ones with c. 5–10 rays, the smaller ones with 1–3, some short, simple hairs in between, margin in the lower half white bearded. Calyx inside with short, simple hairs nearly up to the base (maximally 0.5–1.0 mm glabrous), from 3.0–5.0 mm above the base with increasingly long hairs.

Corolla 20–25 mm long, medium to dark yellow (approximately as in *Onosma taurica* or *Asphodeline lutea*), densely covered with short, more or less patent hairs (except in the basal third), five dorsal stripes often more dense pilose than in between. Corolla-filament-tube 9.0–12.0 mm, free part of the filaments 4.0–6.5 mm, anthers 6.5–8.2 mm long, connected at the very base, insertion of the filament c. 2.5–3.5 mm above the anther base, connective tip c. 1.0 mm long, emarginate, little to distinctly papillate at the margin. Pollen grains c. 16–20 × 12–15 µm.

Nutlets ca. 2.3–3.3 × 1.8–2.1 mm, rhomboidal to slightly oblong, ventrally with a longitudinal edge, a little arched dorsally, smooth, greyish, marbled with brown, shiny, from distinct to indistinct shoulders narrowed into a beak, c. 0.5–1.2 mm long.

Seedlings: Cotyledons finally c. 8–9 × 6–7 mm. The first foliage leaves of the seedlings are relatively wide (Fig. 15), with oblique patent

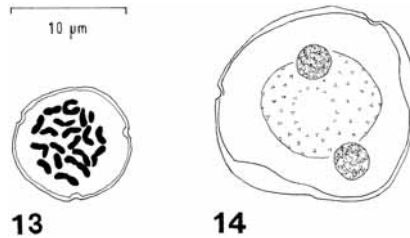


Fig. 13–14. *Onosoma malkarmayorum*. – Fig. 13. First pollen grain mitosis with $n = 19$ chromosomes, from the Vucha valley S Krichim. – Fig. 14. Unreduced pollen grain at the three celled stage, from Grohotno.

hairs and tubercles less dense than in adult ones, and show a clear green. In two month old seedlings the leaves reach up to $10 \times 1.0\text{--}1.2$ cm.

Habitat: Rocks, screes, road embankments, actual material collected between c. 390 and 830 m.

Specimina visa: Bulgarien, Rhodopen, 5 km N von Široka Luka ($24^\circ 36' / 41^\circ 42'$), 800 m; 22. 6. 1980; leg. H. MALICKY (GZU). [$2n = c. 38$, $n = c. 19$]

Bulgarien, Westrhodopen, zwischen Borino und Široka-Läka, ca. 0,8 Straßenkm E der Abzweigung nach Beden, 825 m ($41^\circ 42' 31''$ N, $24^\circ 28' 19''$ E); Marmor, Fels- und Schuttfluren an der Straße; 2. 6. 2007; leg. R. KARL (GZU and herb. KARL). – Cult.-No BOR 1206. [$2n = 38$]

Bulgarien, Westliches Rhodope-Gebirge, Smolian District, Divin Municipality, ca. 200 m S von Grohotno, an der Straße nach Teshel, ca. 830 m, $41^\circ 41,384'$ N / $24^\circ 22,160'$ E; ostexponierte Straßenböschung; 16. 5. 2008; leg. H. MAYRHOFER (type, GZU, SOM). [$n = c. 19$]

Bulgarien, Zentrales Rhodope-Gebirge, Plovdiv District, Vucha-Tal S von Krichim, an der Straße nach Devin, c. 390 m, $41^\circ 59,78'$ N / $24^\circ 28,47'$ E, ostexponierte stark felsige Straßenböschung; 16. 5. 2008; leg. H. MAYRHOFER (GZU, SOM, ATH). [$n = 19$]

Karyology: Mitotic metaphase plates in root tip cells show $2n = 38$ chromosomes (Fig. 12). They show size, shape and transformation during the mitotic nuclear cycle as usual for chromosomes of the *O. echioides* type (e. g., TEPPNER 1972). Unfortunately, it was not possible to invest the time necessary for detailed karyomorphological studies (SAT-zones, idiograms). Meiosis was not observable till now. The metaphase plates of the first and the second pollen grain mitosis (corolla c. 6.7 and 9.5 mm long, respectively) show $n = 19$ chromosomes (Fig. 13). Compare specimina visa. As usual, a small percentage (few grains per anther) of unreduced grains was observed (Fig. 14).

4. Discussion

The asterotrichous *Onosmas* of the *O. echioides*- and *O. heterophylla*-group are relatively difficult to treat because of few very constant morphological traits and high variability on the one hand and by a relative



Fig. 15. *Onosma malkarmayorum*, seedlings soon after germination, material from Beden, cult. no BOR 1206, phot. 24.5.2008. - Scale bar equals 1 cm.

high number of taxa on the other. This situation is not principally altered by the recognition of this new species. However, the separation of *O. stojanoffii* (TURILL) TEPPNER and the new *O. malkarmayorum* permits a clearer delimitation of the widely distributed *O. heterophylla* in the central Balkan Peninsula.

O. malkarmayorum is an endemic of the West Rhodope Mts. (if one use the term in the sense of the geomorphological bifurcation of the Rhodopes with the river Arda as limit). In the case of the floristic subdivision (a tripartition) as used in Fl. Bulg., the main part of the distribution area lies in the Central Rhodopes and the smaller one in the West Rhodopes (river Vãeá as limit).

The new species is sharply delimited by its chromosome number of $2n = 38$ and appears sufficiently characterised morphologically: well developed sterile shoots at flowering time, greyish, narrow leaves of the sterile shoots, with the densely appressed indumentum, subacute upper stem leaves with distinctly dilated base, bracts of lower flowers as long or longer as calyx and pedicel, calyx half as long as corolla or a little longer, corolla dark yellow and densely covered by short hairs.

O. taurica PALLAS (on Crimea with $2n = 26$) possesses totally glabrous corolla tubes and somewhat longer bracts. *O. stojanoffii* (TURILL) TEPPNER (in Bulgaria in Orvilos and S. Pirin; $2n = 14$) is the species most similar. It

has a whitish-yellow to pale yellow corolla and the calyx is usually shorter than half of the corolla.

O. heterophylla GRISEB. ($2n = 14$ and 26), with more or less lemon coloured corollas, is characterised by leaves fading or lacking in c. the basal third of the stem as early as at anthesis and rays of the tubercles not or slightly intermingling and displays, therefore, predominantly greenish leaves. It has few or no sterile shoots at flowering time and bracts usually all shorter than the calyx plus pedicel. It occurs also in the W. Rhodopes (for, e. g., Velingrad, Peštera).

Geographically more distant is *O. rigida* LEDEB. ($2n = 14$) in regions near the Black Sea coast; it has smaller, also pale yellow corollas, and usually shorter, nearly narrow spatulate leaves.

What may be the origin of the chromosome number of $2n = 38$, which appears curious at the first moment within asterotrichous *Onosmas* with the basic chromosome number of $x = 7$. In these *Onosma* groups, at least in our region, in tetraploids the full chromosome number of $7 \times 4 = 28$ is rare. Hypotetraploidy, $2n = 26$, which is a reduction of one pair is usual (as can be seen in the *O. erecta*-, *O. taurica*-, *O. heterophylla*-group and others), arises either by loss of two chromosomes or by translocation to other chromosomes. If in hexaploidization the same process takes place, the hexaploids would not have the full number of $2n = 14 + 26 = 40$ but $2n = 14 + 26 - 2 = 38$! Thus, the term hypohexaploid is applicable for *O. mal-karmayorum*. A likely candidate as donor of the diploid genome is a progenitor of *O. stojanoffii*, but not probably the diploid *O. heterophylla* [$2n = 14$, known from S.E. Bulgaria, Sakar Mts (Mramor) and Strandzha Mts (Zvezdec) till present (TEPPNER unpubl.); also in Greece, former Yugoslavia, Romania and a disjunct, northernmost outpost in Slovakia (TEPPNER 1991a: 39, 1991b: 283, 1996: 49)]. As a donor of the tetraploid genome mainly tetraploid *O. heterophylla* types ($2n = 26$, chromosome counts from W. and Central Bulgaria, Blagoevgrad, Asenovgrad, till now) can be taken into consideration.

5. Acknowledgements

Many thanks go to the three collectors MALICKY, KARL and MAYRHOFER (see chapter eponymy) for providing the material. Sincere thanks to Ass.-Prof. Mag. Dr. E. STABENTHEINER for the SEM photos Fig. 10–11, to Ass.-Prof. Mag. Dr. W. OBERMAYER for the layout of the figures, to Mrs. S. NIKOLOVA for some translations from the Fl. Bulg., to Univ.-Ass. Dr. W. SCHUEHLY for the careful check of the language and to Mr. P. KOSNIK for the photos of the herbarium material.

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