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Remarks to the *Onosma* species *O.bourgaei, O.spruneri* and *O.stellulata* (*Boraginaceae*) offered

By

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S u m m a r y : Remarks to the *Onosma* species *O.bourgaei, O.spruneri* and *O.stellulata* (*Boraginaceae*) offered. – Seed exchange list 1996 (Bot. Garden Inst. Bot. Univ. Graz), p. 33–39.

Nutlets from the three *Onosma* species *O.bourgaei* BOISS., *O.spruneri* BOISS. and *O.stellulata* W.K. are offered in our seed exchange list. Morphological characteristics are discussed. For *O.spruneri* (2n = 12 chromosomes) the chromosome morphology and the prophasic transformation of the chromosomes is described for the first time. For *O.bourgaei* the chromosome number (2n = 16) is a new report too. In connection with the *O.stellulata* group (2n = 22) possible relationship of *O.mattirolii* BALD. (2n = 14) is discussed.

In the course of my scientific work on the boraginaceous genus *Onosma* we have brought many interesting and some very beautiful species under cultivation. Due to the climatic and edaphic problems attached with the cultivation of these often very sensitive species many of them could not survive under the conditions in our garden.

To ensure the survival of the above mentioned three species in culture, we offer nutlets of them (No. 419–421 in our seed exchange list). It would have been impossible to get a pure and scientifically satisfactory crop if many species of these taxa were to be grown near each other until and unless the flowers were caged and hand pollinated which was not possible due to lack of time and labour. But in the case of these three species from our long experience in growing them in culture, we have observed that they haven't crossed with any other species and after self sowing breed true !

All the three species are perennials and very attractive in the habit. Notes about our experience in growing *Onosma* species can be found in TEPPNER 1989. Exact prognoses about germination ability and the timing of germination are not possible. Most probably the seeds (nutlets) will germinate after the first wintering. To shorten this process a cool and moist stratification for few weeks at temperatures around 0° C is recommended.

Onosma bourgaei BOISS.
(Fig. 1 and 2)

Origin of the offered material: Northern Anatolia. Plants of the Cult. No BOR 933 (Prov. Bolu) and BOR 968 (Prov. Samsun) were cultivated together. This crop is the result of open pollination of progenies of these plants. Harvest August 1995.

This species is attractive and easy to recognise due to it's large (up to 15 cm long and more than 2,5 cm wide) and densely haired leaves on sterile shoots. The leaves are lanceolate or a little obovate, more or less obtuse and covered very densely with stellate hairs (whose rays are ± half as long as the central seta) which are relatively finer and smoother compared to other *Onosma* species. The flowering shoots, mostly with 2–3 cincinni at the apex, reach at the end of anthesis a height of up to more than 50 cm. The cincinni are manyflowered, the flowers have long pedicels which are as long or a little shorter than the calyx. The distally dark- to lemon yellow corollas are pubescent outside and c. 10–15 mm long.

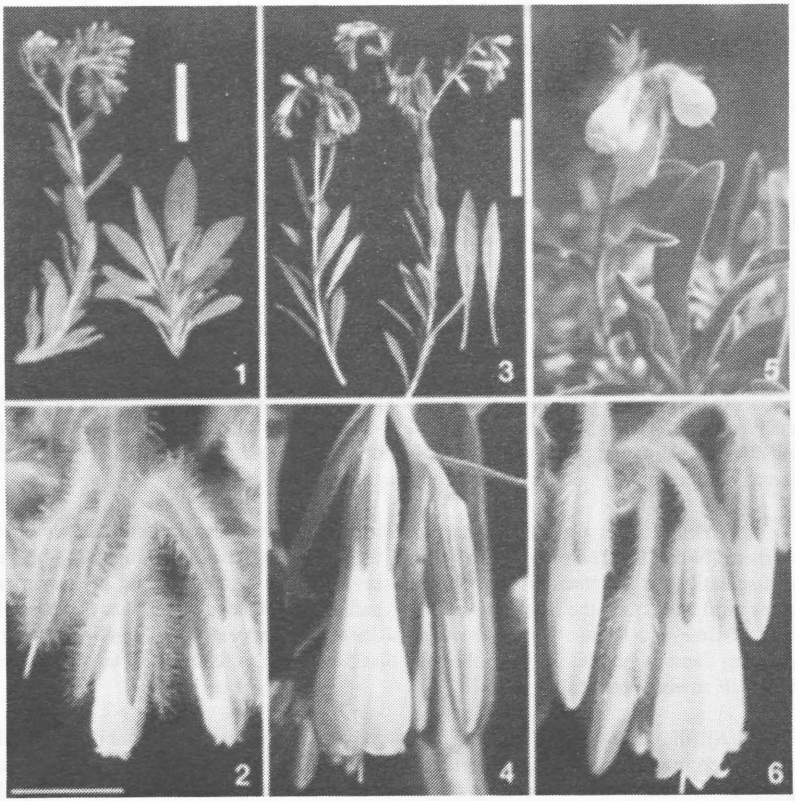

Fig. 1 and 2. *Onosma bourgaei*, Cult. No BOR 933/4 (Fig. 1) and 933/6 (Fig. 2). – Fig. 3 and 4. *Onosma spruneri* Cult. No BOR 800/8 (Fig. 3 right) and 800/9 (Fig. 3 left and Fig. 4). – Fig. 5 and 6. *Onosma stellulata*. Fig. 5 Kroatia, S. Velebit, Crnopac, 15.6.1973. Fig. 6. Cult. s. No, from Kroatia, surroundings of Rijeka, Grobničko polje, c. 290 m. – Black scale bar in Fig. 1 and 3 represents 5 cm. The bar in Fig. 2 equals 1 cm and applies also to Fig. 4 and 6.

The chromosome number was determined on material of the following four collections and is 2n = 16 (mitoses in root tips) and n = 8 (metaphase I, II and anaphase II in pollen mother cells). The chromosome set is apparently heterogenous with respect to the size as well as the form of the chromosomes: The largest pair and a medium sized pair are metacentric; four pairs are submetacentric to subtelocentric and two pairs of SAT-chromosomes are present (Fig. 7). Most probably one of the individuals shows structural heterozygosity of the SAT-chromosome pair with the larger satellites (Fig. 7d). The interphase nuclei contain 4-6 distinct chromocenters and some smaller heterochromatin particles (Fig. 7a). The most dinstinct chromocenters correspond to the four satellites; two chromosome pairs have relatively distinct heterochromatin

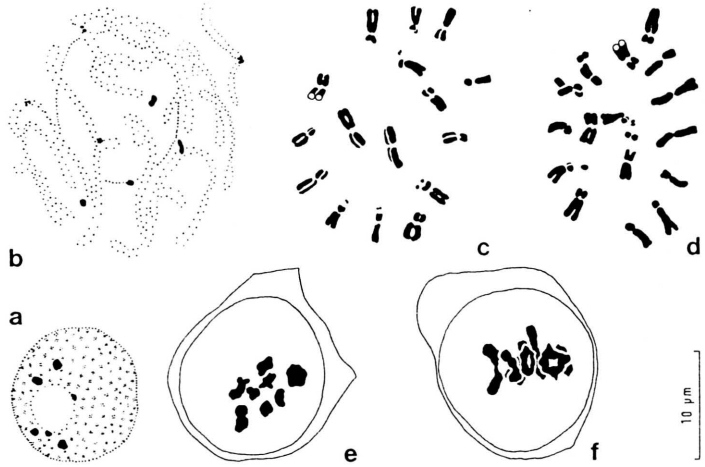

Fig. 7. *Onosma bourgaei.* Mitotic and meiotic chromosomes. – a interphase nucleus. – b early mitotic prophase. – c and d mitotic metaphase plates with 2n = 16 chromosomes. In d the two SAT-chromosomes with the larger satellites have different arm ratios. – e and f meiosis, metaphase I with 8 bivalents: e polar view, f side view. – a BOR 713/1, b and d BOR 968/1, c BOR 948/1, e and f BOR 933/5.

in the centromeric region. The prophasic transformation of the chromosomes follows the *O.*echioides type (Fig. 7b). The chromosome number 2n = 16 originated independently in different groups within the genus *Onosma.*

Anatolien, A4, Zonguldak, Ahmetusta-Paß, Straße Bartin–Karabuk, etwa 1400 m, sonnseitiger Mergel-Steilhang; 10.7.1978; leg. HÜBL 7-10-22. – Cult.No BOR 713, sown 1979 ..... 2n = 16

Türkei, Vilayet Bolu, a.d. Straße Boludağı Geçit – Abant, 27 km NE Abant, 1225 m, Kalk, pontischer Mischwald; 25.7.1977; leg. et fix. G. & W. SAUER 21.589 (Herb.SAUER and Herb. TEPPNER). ..... n = 8

Türkei, Prov. Bolu, Gerede, Kalk, 1400 m; leg. HAGEMANN, BINDER & SCHWARZ 2033. – Bot. G. Berlin-Dahlem 1988 Nr. 104, Akzessionsnummer 401-99-84-14. – Cult. No BOR 933, sown March 1988, germination March/April 1989. – BOR 948, sown May 22, 1989, germination April 1990 ..... n = 8, 2n = 16
Türkei, Samsum, S Çakalli (SW Samsun), 600 m; 14.6.1986; leg. F.SPETA (Herb. SPETA). Cult. No BOR 968, sown Dec. 1989, germination April 1990. ..... 2n = 16

Onosma spruneri BOISS.
(Fig. 3 and 4)

Origin of the offered material: Greece, Peloponnisos, near Agios Vasilios, see below under BOR 764. Open pollination. Harvest August 1995.

O.spruneri is also a very impressive species with a thick, branched, woody, subshrubby base . The elegant, more or less lanceolate, long petiolated leaves of the sterile shoots are 10–26 cm long and 0,5–2,5 cm wide; they show on the under side distinct lateral veins; the sturdy stellate hairs of the upper side and of the midrib of the under side are strongly appressed, while the much softer hairs of the under side of the blade are more or less patent. The inflorescences with 2–3 cincinni reach up to more than 60 cm at the end of anthesis. The flowers are borne on short and thick pedicels. The beautiful, dark yellow, shortly pubescent corollas reach a length of 20–25 mm.

Under the European *Onosma* species *O.spruneri* is a very isolated one and occur only at some localities around the Gulf of Corinth in Greece.

Since for this species only the chromosome number 2n = 12 is published without any further information (TEPPNER 1991a: 31, 1991b: 282), the interesting karyological characters are described below.

The nucleus is relatively poor in heterochromatin, the interphase nuclei show 4 to 8 distinct chromocentres and a number of smaller particles (Fig. 8a). The chromosome set is homo-

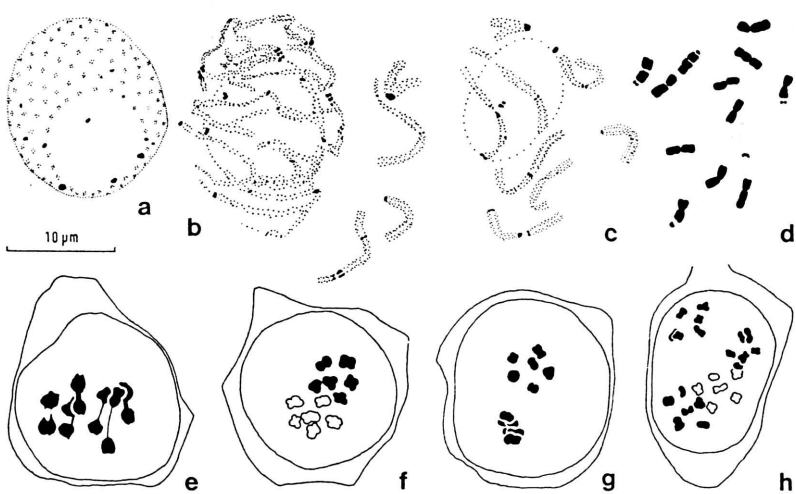

Fig. 8. *Onosma spruneri* with 2n = 12 chromosomes of the *O.echioides* type. – a interphase nucleus. – b,c prophasic transformation. – d metaphase plate. – e–h meiosis. – e transition metaphase I / anaphase I, side view. – f anaphase I, polar view. – g metaphase II. – h anaphase II. – a–c BOR 764/5, d–h BOR 800/8.

genous and relatively symmetrical (Fig. 8d), the exact number of SAT chromosomes (two or three pairs) remains to be clarified by further investigations. Meiosis is very regular with 6 bivalents or chromosomes respectively (Fig. 8 e–h). The chromosome number 2n = 12 is very unusual in asterotrichous *Onosma* species but very common in haplotrichous ones. Therefore it would be of greatest interest to know, if the prophasic transformation of chromosomes follows the *O.echioides* type (TEPPNER 1972) of asterotrichous Onosmas usually with x = 7 or the *O.setosa*-type of haplotrichous species with x = 6 (normal type as in *Vicia faba*). In the fixations we have only snapshots of the transformation without any time marks and in the case of *O.spruneri* the exact comparison with other species proved to be very difficult; thus the different chromosome sets should lie in the same cytoplasm for a clear decision. The artificial cross (bud pollination) of *O.erecta* subsp. *erecta* (2n = 14 with typical *O.echioides*-type chromosomes; mother plant) × *O.spruneri* was successful. The nuclei from the hybrid demonstrated, that the *O.spruneri* chromosomes in prophase follow exactly the *O.echioides* type of transformation as usual in asterotrichous Onosmas (prophase chromosomes of *O.spruneri*: Fig. 8 b, c). In average the *O.spruneri* chromosomes are a little larger than the *O.erecta* chromosomes (the smallest *O.spruneri* chromosomes are as long as the largest *O.erecta* chromosomes).

Griechenland, Peloponnes, Korinthia, Ag. Vasilios, 200 m; 22°47'/37°48'; 5.5.1976; leg. et fix. H.MALICKY (Herb. TEPPNER) ..... n = c.6, 2n = c.12
detto, 21.5.1979 ..... n = c.6, 2n = c.12

Griechenland, Peloponnes, Korinthia, zwischen Korinthos und Argos, ca. 1 km O Ag.Vasilios, ca. 220 m; flache Mergelhänge, Wegböschung im Kulturland (Ölbaum-Haine), mit *Coridothymus capitatus*, *Sarcopoterium spinosum*, *Convolvulus elegantissimus* u.v.a.; 5.7.1980; leg. H.TEPPNER 80/150. – Cult. No BOR 764 ..... 2n = 12
detto, Cult. No BOR 800, sown March 6,1981, germination April 22, 1981 ... n = 6, 2n = 12
detto, Cult. No BOR 885. sown April 4,1986, germination May, 1986 ..... n = 6, 2n = 12

Griechenland, Agios Vasilios; 8.10.1980; leg. H.MALICKY. – Cult. No BOR 856, sown May 3, 1983, germination April 20, 1984 ..... 2n = 12

Onosma stellulata W.K.
(Fig. 5 and 6)

Origin of the offered material: Bosnia, Drina valley, c. 3 km S of Višegrad, c. 320 m, S to SE exposed slope of limestone, scree; July 12, 1974; leg. H. TEPPNER. Open pollination. Harvest August 1975.

In many Botanical Gardens *Onosma* plants are grown as *O.stellulata* and in the seed exchange lists often nutlets are offered under this name. Unfortunately the name *O.stellulata* was used and is used for many taxa with stellate hairs. The plants cultivated in the Botanical Gardens usually belong to the very variable *O.heterophylla* GRISEB. s.l. or to *O.helvetica* BOISS. I possess no evidence for the cultivation of the real *O.stellulata* W.K. in any Botanical Garden.

O.stellulata is easy to recognize under the Europaean asterotrichous species by its dwarf cushion like growth habit with a lignified base of above ground ramifications and subterraneous innovations as well. The leaf-margins are usually flat. At the begin of anthesis the inflorescences are little higher than the leaf tips of sterile rosettes but elongate during and after anthesis up to 20–30 cm. The pedicels are more or less as long as the calyx and the corolla is glabrous except for the very tips (TEPPNER 1981). It's a very nice plant for rock gardens or for the alpine-house.

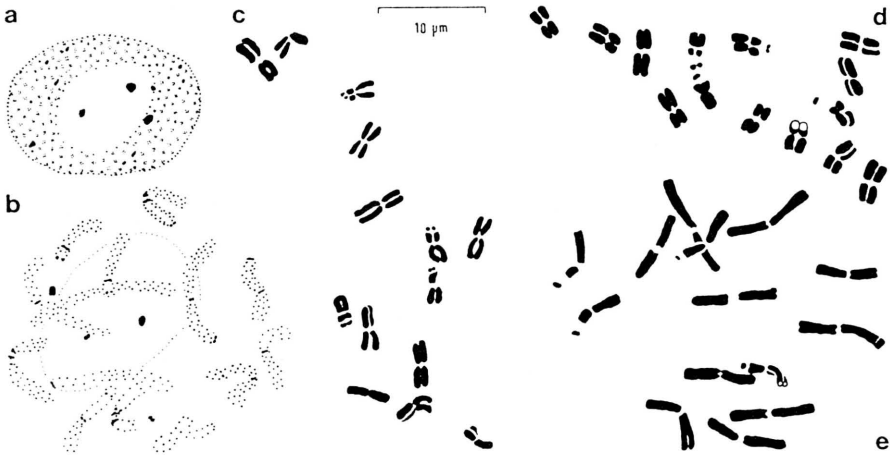

Fig. 9. *Onosma mattirolii* from the Tomorr mountain in Albania, leg. BALTISBERGER & VOGLI No 12956, cult. Bot. G. Univ. Graz. Mitotic nuclear cycle, 2n = 14 chromosomes. – a interphase nucleus. – b late prophase. – c–e metaphase plates.

O.stellulata belongs to a characteristic group of three species (others: *O.pygmaea* RIEDL and *O.leptantha* HELDREICH) which occur in the Western Balkan Peninsula (TEPPNER 1981, 1991a). They have the unique derived chromosome number n = 11, 2n = 22 and a derived chromosome morphology (a heterogenous and asymmetric set) (TEPPNER 1971: 220–221, 1979, 1981, 1991a, IATROÚ 1986: 164–165). From the morphological point of view *O.mattirolii* BALDACCI from the Tomorr mountain in Albania seems to be close to this group (TEPPNER 1981: 305–306); but this species has the chromosome number of 2n = 14 (BALTISBERGER 1995: 462, 463; Fig. 9), which is very common in asterotrichous Onosmas and possesses also the same mode of prophasic transformation of chromosomes. But the chromosome morphology looks very different from that shown in the drawing of BALTISBERGER; except for the SAT-chromosomes – all other chromosomes possess centromere positions in the median region: Fig. 9 c–e. The nuclei are poor in heterochromatin. The four most apparent chromocenters are the satellites. The smaller particles represent largely proximal heterochromatin (Fig. 9 a and b). If the morphological view is correct, then the only conceivable way of evolution is from 14 to 22 chromosomes and triploid individuals (2n = 21) or tetraploids (2n = 28) are imaginable as an intermediate step. The progenitors of the extreme relict *O.mattirolii* then could link the *O.stellulata* group with other asterotrichous species. Encouraged by these new results a reinvestigation of the relationships is under work. Most probably *O.sangiasense* TEPPNER & IATROÚ (TEPPNER & IATROÚ 1987, TEPPNER 1991a: 32–33) must also be added to this group, but no karyological information is available up till now.

Acknowledgements

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