

Bellevalia vuralii B.Şahin & Aslan (Asparagaceae): a new species from SE Turkey

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Received: 05.05.2015 • Accepted/Published Online: 01.01.2016 • Final Version: 07.06.2016

Abstract: *Bellevalia vuralii* B.Şahin & Aslan is described as a new species of *Bellevalia* from southeast Turkey. As well as its morphological characteristics and classification with regards to sections, its description, ecology, and relationship with related species are presented and discussed. The somatic chromosome number of these species was defined to be $2n = 8$.

Key words: *Bellevalia*, Asparagaceae, Siirt, Turkey

1. Introduction

Bellevalia species are distributed in three different phytogeographical regions: Mediterranean, Saharo-Sindian, and Irano-Turanian (Feinbrun-Dothan, 1940). The Irano-Turanian phytogeographical region is the most important, with high distribution of the species. The genus is represented by 4 sections with 45 species according to Feinbrun-Dothan. When distribution and endemic regions are examined, the Irano-Turanian region is observed as the main area for species distribution, while Iran and Turkey are introduced as areas where new species are to be expected (Feinbrun-Dothan, 1940).

The genus is represented by 6 sections (Feinbrun-Dothan, 1940; Persson and Wendelbo, 1979; Wendelbo, 1980) with approximately 70 species according to studies published around the world (Gürdal et al., 2014; Karabacak et al., 2014, 2015). The richness in the diversity of the species lies in its distinctive characteristics regarding leaf width and pubescence, raceme shape and density, pedicel length in relation to perianth length, perianth length, the tube:lobe ratio, perianth color, and anther color (Cowley et al., 1994).

Within the *Flora of Turkey*, there are 18 species, 7 of which are endemic (Wendelbo, 1984). Later, 3 more species were added in the second additional volume (Özhatay, 2000). Following the introduction of *B. leucantha* K.Perss. (Persson, 2006), a checklist was published (Tugay, 2012). Tugay listed 23 species in the checklist by taking the synonyms and questionable records into consideration. *B.*

glauca Kunth is replaced by *B. chrisii* Yıldırım & B.Şahin (Yıldırım et al., 2014). The number of *Bellevalia* species increased in Turkey in recent years with new studies: *B. malatyaensis* Uzunh. & H.Duman, *B. pseudolongipes* Karabacak & Yıldırım, *B. koyuncui* Karabacak & Yıldırım, *B. pseudofominii* Özhatay & E.Kaya, *B. undulatifolia* Özhatay, Gürdal & E.Kaya, and finally *B. sirnakensis* (Yıld.) Yıld. (Uzunhisarcıklı et al., 2013; Gürdal et al., 2014; Karabacak et al., 2014, 2015; Yıldırım, 2015).

Unless otherwise specified, the anther color of *Bellevalia* species is either violet or variations of violet (Wendelbo, 1984). As a matter of fact, there are only 2 species reported in the monograph with a different anther color, yellow (*B. dichroa* Hausskn. ex Bornm. and *B. fominii* Woronow) (Feinbrun-Dothan, 1940). In the floras of other countries written later on, violet is the dominant anther color and only a few species with yellow anthers are reported (Boissier, 1865–1888; Komarov, 1968; Wendelbo, 1990). In the Turkish flora, there are 18 *Bellevalia* species. Three of the species are distributed within the eastern part of the country and one of which, later reported as a synonym, has yellow anthers: *B. modesta* Wendelbo, *B. pycnantha* (K.Koch) Losinsk., and *B. paradoxa* (Fisch. & C.A.Mey.) Boiss. (Wendelbo, 1984). Moreover, 6 out of the 11 species identified later also have yellow anthers and 8 of these are distributed in the eastern part of the country: *B. edirnensis* Özhatay & B.Mathew, *B. anatolica* B.Mathew & Özhatay, *B. leucantha*, *B. pseudolongipes*, *B. koyuncui*, and *B. sirnakensis* (Wendelbo, 1984; Özhatay et al., 1991b;

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Cowley et al., 1994; Persson, 2006; Gürdal et al., 2014; Karabacak et al., 2014, 2015; Yıldırım, 2015).

The area where the samples are gathered is one of the branches of the River Dicle, Botan stream valley, on which the Ilisu dam is planned to be constructed. The floristic structure of the area, which is composed of steppe and degraded oak coppices, is still not fully discovered and that is why even local studies may reveal new improvements. Recently, *Salvia siirtica* (Kahraman et al., 2011) was described as a new species from Siirt. Furthermore, *Michauxia nuda* A.DC. (Aslan et al., 2010), *Silene monerantha* Williams (Kaya and Ertekin, 2009), and *Teucrium chasmophyticum* Rech.f. (Dönmez, 2006) are recorded as new species collected from the Botan stream valley. Furthermore, the valley of the River Dicle is home for the best population of *Echinops phaeocephalus* Hand.-Mazz., which is a species with a rare distribution.

Some studies of different *Bellevalia* species have been carried out using cytogenetics. The somatic chromosome numbers of the genus *Bellevalia* are counted as $2n = 8, 12, 16, 17, 20, 24, 32, 33, 35$. In addition, the basic chromosome number is reported on *Bellevalia* species as $x = 4$ (Bothmer and Wondelbo, 1981; Özhatay et al., 1991a; Özhatay and Johnson, 1996; Kypriotakis and Tzanoudakis, 1999; Özhatay, 2002; Johnson, 2003; Jafari et al., 2008; Bareka et al., 2012; Loewenstern et al., 2013).

2. Materials and methods

Plant samples were collected during an expedition to the Ilisu basin (River Dicle and its branches). The description of the Turkish flora was done by reviewing the flora of neighboring countries and relevant literature (Komarov, 1968; Wendelbo, 1984, 1990; Feinbrun-Dothan, 1986; Özhatay et al., 1991a; Cowley et al., 1994; Brullo and

Minissale, 1997; Kypriotakis and Tzanaoudakis, 1999; Tan et al., 2007; Jafari and Maussoumi, 2008; APG III, 2009; Brullo et al., 2009; Shuka, 2010; Karabacak et al., 2014). Herbarium specimens (GAZI) and live materials (Nezahat Gökyiğit Botanic Garden: NGBB) were analyzed for comparison. After it was understood that it was a new species, flowering and fruit samples were collected again during another expedition to the area. The description of the new species is based on approximately 20 samples. The threat classification was determined in accordance with the IUCN (2012).

The karyotype was made on somatic metaphases using Image System Analysis (Bs200Pro). Root meristems from germinating bulbs collected in the wild were used. Root tips were pretreated with α -monobromonaphthalene at 4 °C for 16 h. Root tips were fixed with Carnoy's for 24 h at 4 °C. Before staining, the material was hydrolyzed with 1 N HCl for 9 min at room temperature. The chromosomes were stained with 2% acetic orcein and mounted in 45% acetic acid. Permanent slides were made by using the standard liquid nitrogen method. Photographs were taken through a BX51 Olympus microscope. Chromosomes were classified using the nomenclature of Levan et al. (1964).

3. Results

3.1. *Bellevalia vuralii* B.Şahin & Aslan sp. nov. (Figures 1–5).

Type: TURKEY, Siirt: Siirt-Eruh yolu, Sağlarca köyü, bozkır, 463 m, 14.04.2009, S. Aslan 3148 & B. Şahin; (holotype: DUOF 5750!, paratypes: ANK!, GAZI!, DUOF!).

Diagnosis: *Bellevalia vuralii* resembles *B. malatyaensis* and *B. kurdistanica*. It differs from *B. malatyaensis* with leaves 10–15 (–20) cm (not 5–10 cm), 4–15 mm (not



Figure 1. (A) Habitat and (B) habitus of *Bellevalia vuralii*.



Figure 2. Habitus (A), fruit (B), leaves (C), and anthers (D) of *Bellevalia vuralii*.

10–25 mm), longer than scape (not shorter than scape), linear-elliptic (not lanceolate-elliptic), apex entire, margin undulate, scarcely ciliate (not apex cucullate, margin entire, distinctly ciliate); pedicel 5–15 mm in flower (not 8–30 mm); anther yellow, dorsally connected, 1–1.5 mm (not violet, basally connected, 0.3 mm); perigon crimson bluish-violet in bud, lobes 2/5 of tube (not white to greenish, lobes 1/2 of tube); capsule obovate-cordate, 8 × 8 mm (not lanceolate-orbicular, 3–7 mm long). It differs from *B. kurdistanica* with leaves 2–3 (not 5–6); pedicel longer than flowers, erecto-patent (not as long as perianth, arcuate); anther yellow (not lilac); perigon crimson bluish-violet in bud, 5–7 mm (not greenish, 9–11 mm); chromosome number 8 (not 16).

Description: Bulb ovoid-subglobose, 1–2 cm diameter, outer tunic coriaceous, brownish; inner tunic papery, pinkish to light brownish. Leaves 2–3(–4), linear-elliptic, undulate, longer than scape in flowering and fruiting time, outer and inner leaves 10–15(–20) cm long; inner leaves 4–8 mm and outer leaves 10–15 mm broad, thin,

glaucous; narrowly cartilaginous, minutely papillose. Scape 1(–2), 3–10(–18) cm long, green to yellowish-green. Raceme cylindrical or slightly conical in flowering and fruiting time, rather dense, 3–5(–7) cm long, elongating to c. 10 cm in fruit, rachis purplish to purplish-green in flowering time, yellowish-green in fruiting time. Bracts entire or slightly bilobed, minute, pinkish to purplish, triangular to oblong. Pedicels erect before anthesis, later elongating and becoming recurved, finally elongate and erect, 1–3× longer than flowers, erecto-patent in flowering and fruiting time, horizontally ascending or erect, 5–15 mm long in flowering time, 15–30 mm in fruiting time, purplish to purplish-green. Flowers 15–30 (–35), 5–7 mm long, tubular-campanulate, perianth bluish violet in bud, later pale brownish-green on tube and brownish nerves; perianth tube 3–5 mm long; lobes 2 mm long, 1/3 of tube, subequal, ovate-lanceolate, green to dirty whitish, distinctly shorter than tube. Stamens with flat, narrowly triangular, retuse, dorsally connate filaments attached just below base of perianth lobes; anthers yellowish, 1–1.5

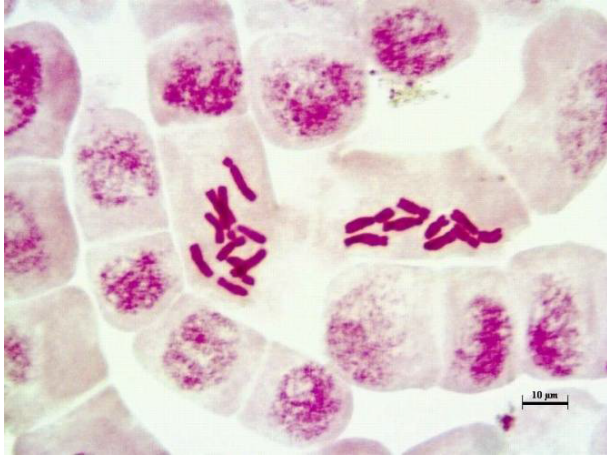


Figure 3. Somatic chromosomes in *Bellevalia vuralii*. Bar: 10 µm.

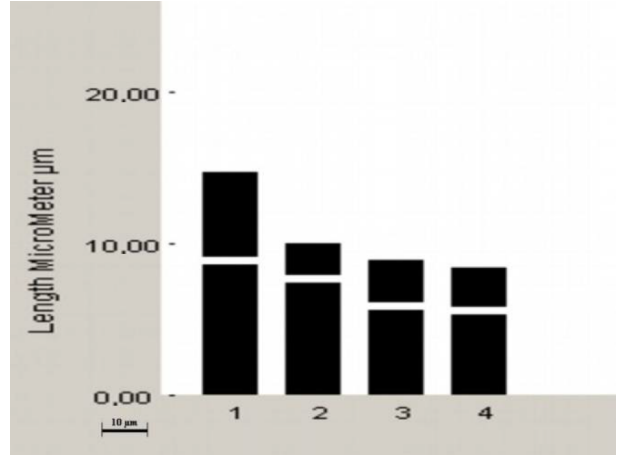


Figure 4. Ideogram of *Bellevalia vuralii*. Bar: 10 µm.

mm, reaching at least the apex of the lobes and visible in the mouth of the flower. Capsule triquetrous, 8 × 8 mm diameter, retuse at apex, cordate or widely obovate, valves thin, dehiscent, persistent. Seeds globose-ellipsoid, c. 2 mm, black, shiny.

Flowering time March to April, 400–500 m, in open forest.

Turkish Name: “Dicle Kırsümbülü”

Etymology: This species is named in honor of the eminent Turkish botanist and our valued mentor Prof Dr Mecit Vural (Gazi University).

Habitat and ecology: *Bellevalia vuralii* grows in clearings and eroded slopes within oak forests, where *Quercus brantii* Lindley is dominant. Botan Stream valley, where Sağlarca village is located, is covered with scarcely distributed *Q. brantii* coppices. In spite of the stream

flowing through the area, the bioclimatic structure of the region caused oaks and degraded oak coppices to be interwoven with steppe. Especially highly affected areas by human action are covered with fields and steppe. Other species growing together with the described species within the forest and clearings are as follows: *Onosma alborosea* Fisch. & C.A.Mey., *Juniperus oxycedrus* L., *Klasea oligocephala* (DC.) Greuter & Wagenitz, *Cota tinctoria* (L.) J.Gay ex Guss. var. *tinctoria*, *Scorzonera papposa* DC., *Micropus supinus* L., *Coronilla scorpioides* (L.) W.D.J.Koch, *Medicago radiata* L., *Astragalus macrostachys* DC., *Bunium microcarpum* Boiss. & Freyn subsp. *microcarpum*, *Valeriana dioscoridis* Sm., *Imperata cylindrica* (L.) Raeusch., *Campanula saxonorum* Gand., *Microthlaspi perfoliatum* (L.) F.K.Mey., *Gundelia tournefortii* L., *Sinapis arvensis* L., and *Euphorbia craspedia* Boiss.

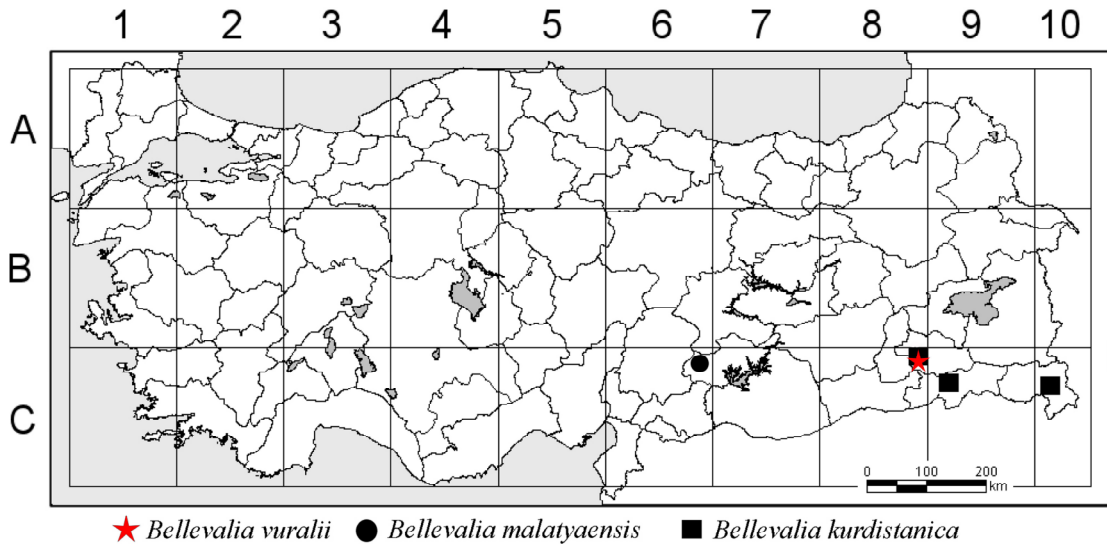


Figure 5: Distribution map of *B. vuralii*, *B. kurdistanica*, and *B. malatyaensis*.

Table 1. Measurements (μm) of somatic chromosomes in *Bellevialia vuralii*, (*m = metacentric, **Sm = submetacentric,***St = subtelocentric).

Chromosome pair no.	Chromosome arms (μm)		Total length (μm)	Arm ratio (L/S)	Relative length (%)	Centromeric index	Chromosome type
	Long arm (L)	Short arm (S)					
1	8.57	5.63	14.20	1.52	35.36	14.03	m*
2	7.43	2.13	9.56	3.48	23.82	5.32	St***
3	5.61	2.85	8.46	1.97	21.07	7.11	Sm**
4	5.29	2.63	7.93	2.01	19.74	6.56	Sm

Total length of haploid complement: 40.15 μm

Table 2. Comparison of the morphological characters of *B. vuralii*, *B. malatyaensis*, and *B. kurdistanica*.

Characters	<i>B. vuralii</i>	<i>B. malatyaensis</i>	<i>B. kurdistanica</i>
Leaves	2-3(-4) 4-15 mm wide Longer than scape Linear-elliptic Apex entire, margin undulate	1-2 (-3) 10-25 mm wide Shorter than scape Lanceolate-elliptic Apex cucullate, margin entire	5-6 14-17 mm wide Longer than scape Lorate-linear
Scape	1(-2)	1	1-2 (3)
Raceme	Slightly conic Rachis purplish in flower yellowish green in fruit	Cylindrical Rachis bluish	Ellipsoid to cylindrical Rachis violet
Pedicele	Longer than flowers 5-15 mm in flower, 15-30 (-35) mm in fruit Erecto-patent	Longer than flowers 8-30 mm in flower, 35 mm in fruit Horizontal	As long as perianth to 20 mm in fruit Arcuate
Flowers	15-30	10-22	20-40
Anther	Yellow 1-1.5 mm	Violet 0.1-0.3 mm	Lilac 1.5 mm
Tepal and lobes	5-7 mm Crimson purple in bud lobes 1/3 tubes	4.5-6 mm White to greenish in bud lobes 1/2 tubes	(8-) 9-11 mm Greenish white with purplish tinge in bud Lobe 1/2 tubes
Capsules	Cordate-obovate, 8 x 8 mm	Lanceolate-orbicular, 3-7 mm long	12-13 x 9-10 mm, suborbicular
Chromosomes	8	8	16

Additional specimens examined (paratypes): TURKEY, Siirt: Eruh, Sağlarca köyü, orman açıklığı, 470 m, 06.05.2011, *B. Şahin* 4890 (GAZI, ANK); Siirt: Eruh, Sağlarca köyü, orman açıklığı, 496 m, 12.04.2014, *O. Karabacak* 9037 (GAZI, DUOF); ibid., 25.04.2013, *O. Karabacak* 8823 (GAZI, DUOF, ANK).

***B. malatyaensis*:** Malatya: from Erkenek to Gölbaşı, 15 km, 800-1000 m, under the fairly open canopy of a *Pinus*

brutia forest, 17.04.2005, *M.E. Uzunhisarcıklı* 2019, GAZI.

***B. kurdistanica*:** Siirt: Siirt Üniversitesi, Kezer Yerleşkesi, step, 950 m, 11.04.2013, *O. Karabacak* 8777 (GAZI); Şırnak: Şırnak-Eruh arası 15. km, kumtaşı tepe, 1300 m, 25.04.2004, *MKOY* 14105, (NGBB-live material); Şırnak: *MKOY* 14191 (NGBB-live material).

Conservation status: The species is only identified by its type locality. The distribution area is estimated to

be less than 10 km². Individuals observed in the living area are very low in number, thought to be less than 1000 individuals. The living area is within the limits of the catchment. Also in this area, oak coppices are replaced with steppe due to the climate and anthropogenic factors. Therefore, the threat classification is suggested to be CR [B2ab(i+iii)] (IUCN, 2012).

3.2. Cytology: Our study showed that the chromosome number of *B. vuralii* is new for science and $2n = 8$ (Figure 3). The shortest chromosome length is 7.93 µm, the longest is 14.20 µm, and haploid chromosome length is 40.15 µm. Chromosome arm ratios are measured as 1.52–3.48. Centromeric index varies between 6.56 and 14.03 and relative lengths vary from 19.74 to 35.36 (Table 1). The karyotype formula of this species consists of one metacentric chromosome pair, two submetacentric chromosome pairs, and one subtelocentric chromosome pair. The ideogram was drawn based on the centromeric index and arranged in decreasing size order (Figure 4).

The somatic chromosome number of *B. malatyaensis* is reported to be $2n = 8$ by Uzunhisarcıklı et al. (2013). Besides being the closest species to the one studied in the present paper, both species have the same number of somatic chromosomes; however, there is a difference in regards to karyotype formula and the results of the chromosome analysis. The karyotype formula of *B. malatyaensis* is $2M+1Sm+1St$ and for *B. vuralii* it is $1m+2Sm+1St$. Total length of *B. malatyaensis* chromosomes varies from 13.40 to 24.01 µm. Total haploid length of *B. malatyaensis* chromosomes is reported as 70.22 µm (Uzunhisarcıklı et al., 2013), whereas total length of *B. vuralii* chromosomes varies from 7.93 to 14.20 µm, which is shorter than that of *B. malatyaensis*. Accordingly, total haploid length of *B. vuralii* chromosomes is determined to be 40.15 µm. The differences in karyotype formulas and analysis results prove that these two species are not cytogenetically similar.

4. Discussion

B. vuralii resembles *B. malatyaensis* and *B. kurdistanica* according to the *Flora of Turkey* (Wendelbo, 1984; Uzunhisarcıklı et al., 2013). *B. vuralii* differs from these species based on the characteristics given in Table 2. According to the identification key in the *Flora of Turkey*, *B. vuralii* belongs to the laxly flowered group. The species in this group have wide leaves and long pedicels. However, only *B. kurdistanica* has narrow leaves and short pedicels.

In contrast to the other species generally growing on steppes (Wendelbo, 1984), *B. vuralii* demonstrates diversity at habitat level as it grows inside forests and open forests. *B. vuralii* differs with its shorter length and delicate structural characteristics in regards to habitus among other laxly flowered and longer species. In the

present study another species having yellow anthers and distributed in the eastern part of Turkey is also identified; with this recent addition, the number of species having yellow anthers rises to 9. Another species, *B. wendelboi* Maassoumi & Jafari, identified in the Iranian flora also has yellow anthers (Jafari and Maasoumi, 2008). Although the number of species having yellow anthers increases, the systematic importance of anther color is still not known clearly (Feinbrun-Dothan, 1940; Persson and Wendelbo, 1979). Future studies may address taxonomic issues and suggest answers.

Most of the recently identified species can generally be placed under existing sections; however, it is seen that because of certain characteristics they do not simply fit into those sections. For instance, *B. malatyaensis*, under the section *Conica*, does not match the cylindrical raceme characteristic of the section (Uzunhisarcıklı et al., 2013) or the situation is the same with *B. anatolica* (Cowley et al., 1994). As for *B. vuralii*, considering the morphological characteristics of the species, it belongs to sect. *Conica*; however, having leaves longer than the scape the species can also be categorized under sect. *Patens*, or, considering the shape of the capsule, the species can also be categorized under sect. *Nutans*. The current study places *B. vuralii* species under sect. *Conica* (Feinbrun-Dothan, 1940); therefore, the number of distributed species in Eastern Anatolia–Iran region under sect. *Conica* has risen.

More than 30 species were identified after Feinbrun-Dorath and over 25 of these species belong to the Irano-Turanian phytogeographical region. Fifteen of these species were identified in Anatolia and 10 were identified in Iran (Jafari and Maasoumi, 2008). Twelve of the species identified in Anatolia were found in areas near Iran. These findings show that endemic species are concentrated in the eastern part of the country, which proves Feinbrun-Dorath's forecast (1940). However, the identified species lead to systematic problems because of their characteristics such as anther color, flower, fruit, scape, and raceme and also the section under which they are categorized. Therefore, the status of the sections and the species under these sections needs to be reviewed and revised. It will be beneficial to check the systematic status of the species by incorporating cytological and phytogeographical data. This is necessary for establishing a systematic order among the species.

By adding *B. vuralii*, which is identified in this paper, the number of *Bellevalia* species in Turkey rises to 30 and the number of endemics to 19.

Acknowledgment

We would like to thank the Nature Society (Doğa Derneği) for their financial support.

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