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Scilla hakkariensis, sp. nov. (Asparagaceae: Scilloideae): a new species of *Scilla* L. from Hakkari (eastern Anatolia)

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ABSTRACT
Scilla hakkariensis, sp. nov. (Asparagaceae), described herein as a new species to science, is endemic to the eastern Anatolian region of Turkey. It is related to *S. libanotica* Speta and *S. mischtschenkoana* Grossh., but clearly differs from them based on the morphological differences presented in the species description. Specifically, it is easily distinguished from both of them by its seeds without elaiosome. In addition, the conservation status, a distribution map, and notes on the biogeography and ecology of the new species are given.

KEY WORDS
Asparagaceae,
Hakkari,
Scilla,
new species.

RÉSUMÉ
Scilla hakkariensis, sp. nov. (Asparagaceae: Scilloideae) : une espèce nouvelle de Scilla L. d'Hakkari (Anatolie orientale).
Scilla hakkariensis, sp. nov. (Asparagaceae), ici décrite comme nouvelle pour la science, est endémique d'Anatolie orientale (Turquie). Elle est affine de *S. libanotica* Speta et *S. mischtschenkoana* Grossh., mais s'en distingue clairement par quelques traits morphologiques exposés dans la diagnose, notamment l'absence d'élaiosome sur les graines. En outre, son statut de conservation, sa répartition et des notes sur sa biogéographie et son écologie ont été précisés.

MOTS CLÉS
Asparagaceae,
Hakkari,
Scilla,
espèce nouvelle.

INTRODUCTION

Many taxonomical studies have been made on the status of the genus *Scilla* and *Scilla* species (Speta 1998a, b; Stedje 1998; Pfosser & Speta 1999). Speta (1998a) separated the genus *Scilla* s.l. into many small genera via morphological, karyological, and DNA sequencing techniques. Govaerts (2018) accepted that and kept the status of the genera *Prospero* Salisb., *Zagrosia* Speta, *Fessia* Speta, *Pseudoprospero* Speta, *Schizocarphus* Merwe, *Merwilla* Speta, *Ledebouria* Roth, and *Hyacinthoides* Medicus in the Speta system in the world checklist of selected plant families. However, the genera *Autonoe* (Webb & Berthel.) Speta, *Chouardia* Speta, *Nectaroscilla* Parl., *Schnarfia* Speta, *Othocallis* Salisb., *Oncostema* Raf., *Pfosseria* Speta, and *Tractema* Raf. were not accepted (Govaerts 2018). According to Speta, *Scilla armena* Grossh., *S. cilicica* Siehe, *S. libanotica* Speta, *S. mischtschenkoana* Grossh., *S. rosenii* K.Koch, and *S. siberica* Andrews, etc., belong to the genus *Othocallis* Salisb. We follow Govaerts (2018) and treat here all these taxa within genus *Scilla*, *Othocallis* is not a separate genus from *Scilla* (Yıldırım 2012). In contrast to Speta (1998a), we evaluated the taxa under *Scilla* s.l. as paraphyletic (Yıldırım 2012). Moreover, the morphological differentiation between *Othocallis* and *Scilla* (e.g., bract short [in *Othocallis*], bract very short, collar-shaped or irregular shaped [in *Scilla*]; scapes 1-several [in *Othocallis*], scape 1[in *Scilla*]; and testa papillose [in *Othocallis*], testa smooth [in *Scilla*]) are not of high importance when separating this genus from *Scilla* s.l.

According to Speta (1998b), only *Scilla bifolia* L. and closely related taxa, which included *Chionodoxa* Boiss., formed the genus *Scilla* s.s.

Within the scope of the World Checklist of Selected Plant Families, Govaerts (2018) indicated that the total number of *Scilla* L. taxa is 93, with distribution in Europe, Africa, and western Asia.

The first revision of *Scilla* in Turkey was carried out by Mordak (1984), according to him, *Scilla* is represented by 14 species there.

Yıldırım (2012) specified 16 *Scilla* species (including *Chionodoxa*) and reported a hybrid in the last checklist of Turkish plants. He resurrected the status of *Scilla persica* Hausskn. and *Scilla siehei* (Baker) Speta, contrary to that reported by Govaerts (2018). According to Yıldırım (2012), a total of six species are endemic to Turkey.

Yıldırım *et al.* (2013) described an unusual and morphologically very strange *Scilla* species named *Scilla vardaria* Yıldırım & Gemici. Although *S. vardaria* exhibits several *Scilla* features, it has a floral corona like that of *Puschkinia* Adams. After this discovery, the morphological limitations of *Scilla* were changed and confused. In recent years, three new *Scilla* species were discovered in Turkey, which are *Scilla arsusiana* Yıldırım & Gemici (Yıldırım *et al.* 2014), *Scilla alinihatiana* Aslan & Yıldırım (Yıldırım & Aslan 2015) and *Scilla bilgineri* Yıldırım (Yıldırım & Altıoğlu 2017). Yıldırım emphasized that the seed features are of high importance for the taxonomy of *Scilla* taxa (Yıldırım *et al.* 2013, 2014; Yıldırım & Aslan 2015; Yıldırım & Altıoğlu 2017).

From a plant biodiversity aspect, the Cilo and Sat Mountains in the province of Hakkari in eastern Turkey are very rich areas. Not only the geographic structure, but also the military-security conditions have obstructed the area from being explored. According to the literature, after Joy Garden, who carried out the first floristic investigation in Hakkari in 1858, a total of 22 foreign botanists have performed investigations and collected nearly 700 taxa from Hakkari (Fırat 2013, 2014). In spite of this, this area remains greatly unexplored thanks to the Cilo and Sat mountain chain, which is approximately 80 km long and extends to the Iraqi border. This area comprises many unexplored regions that still contain completely wild habitats. In recent years, many new taxa have been discovered at this area, such as *Clinopodium hakkaricum* Dirmenci & Fırat (Fırat & Dirmenci 2009), *Verbascum kurdistanicum* Fırat (Fırat 2015), *Cirsium semzinanicum* Fırat (Fırat 2016c), *Iris koyuncui* Fırat (Fırat 2016a), *Saxifraga hakkariensis* Fırat (Fırat 2016b), *Stachys hakkariensis* Akçiçek & Fırat (Akçiçek *et al.* 2016), *Gundelia colemerikensis* Fırat (Fırat 2016d), *Iris zagrica* B. Mathew & Zarrei subsp. *hakkariensis* Fırat (Fırat 2017).

The first author collected an interesting *Scilla* taxon in two populations from the Şemdinli and Çukurca districts of Hakkari, which the authors believe to be a new species to science.

MATERIAL AND METHODS

The specimens of *Scilla hakkariensis* sp. nov. were examined using a stereo binocular microscope. In total 70 living and 20 herbarium samples of this new species were examined. At least 40 mature seeds and 50 pollen grains were measured using light microscopy. For scanning electron microscopy (SEM), the selected pollen grains were placed on aluminum stubs, coated with gold using a Quorum Q150 RES Coater, and examined using an Carl Zeiss 300VP SEM. The specimens were compared with many other *Scilla* specimens collected from different localities and deposited in various international and national herbaria such as AIBU, ANK, E, EGE, G, GAZI, HUB, ISTE, ISTF, K, KATO, KNYA, P, VANF, W and WU. Relevant literature sources were also consulted during the identification and outlining of the specimens (Mordak 1984; Speta 1998a, b; Pfosser & Speta 1999; Yıldırım 2012, 2014; Yıldırım *et al.* 2013, 2014; Yıldırım & Aslan 2015; Yıldırım & Altıoğlu 2017; Govaerts 2018).

TAXONOMIC TREATMENT

Scilla hakkariensis Fırat & Yıldırım, sp. nov.
(Figs 1; 2)

Scilla hakkariensis, sp. nov. is related to *S. libanotica* Speta and *S. mischtschenkoana* Grossh. It differs from both of them by its seeds without elaiosome (elaiosome is not distinct on the raphe). Also *Scilla hakkariensis*, sp. nov. is easily separate from related species by the following features: tepal 10-15 (12.8±1.3) mm long and filaments

Fig. 1. — *Scilla hakkariensis*, sp. nov.: **A**-**D**, habitus; **E**, **F**, populations areas; **G**, fruit; **H**, seeds.

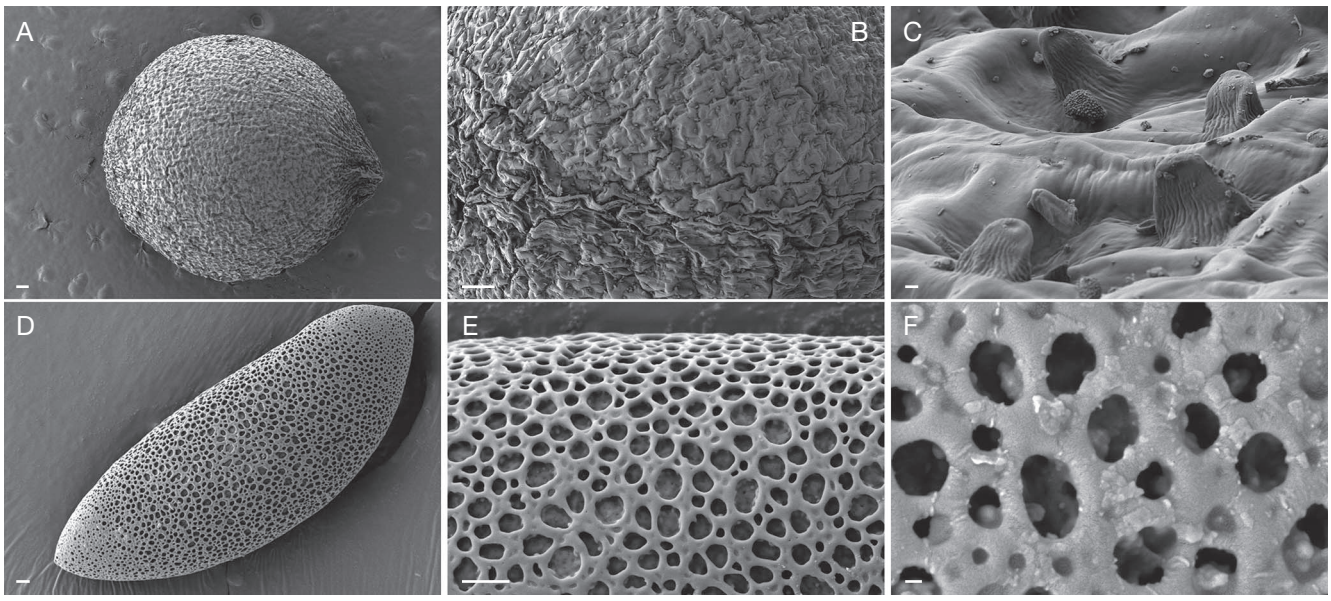

Fig. 2. — *Scilla hakkariensis*, sp. nov., SEM photos: **A**-**C**, seed and details of seed surface; **D**-**F**, pollen grains and details of exine. Scale bars: A, B, 100 µm; C-E, 2 µm; F, 200 nm.

6-8 (7.2±0.8) mm long (14-20 [17.7±1.7] mm and 8-11 [9.2±1.2] mm in *S. mischtschenkoana*); tepals whitish to very pale pinkish-blue, styles 4-7 (5.3±1.3) mm long (light blue, 7-10 [8.4±1.4] mm in *S. libanotica*).

Type. — **Turkey**, Hakkari: Şemdinli district, Gelyaşîn region, on rock areas and *Crataegus* bushes opening, 890 m, 37°4'45"N, 44°25'46"E, 7.IV.2012, *M. Fırat 28629* (holo-, VANF!; iso-, EGE!, HUB!, VANF!, and in the personal herbarium of the collector Herb. Fırat!.).

Pollen morphology. — The pollen grain is dark bluish-purple, heteropolar, monosulcate, pollen shape perprolate, equatorial diameter 22-25 µm, polar axis 57-73 µm, exine ornamentation perforate (Fig. 2).

Etymology. — The species epithet is derived from Hakkari province, where the new species was first discovered.

Vernacular name. — *Scilla hakkariensis*, sp. nov., is called (Kurdish name) "Berfine" by the local people of the Şemdinli district of Hakkari province.

Suggested conservational status. — *Scilla hakkariensis*, sp. nov., is represented with two discovered populations in Hakkari province. Total area of occupancy is smaller than 20 km² and observed individual numbers about 800 in total for these two populations. Following the criteria laid out by IUCN (2013), the plant is categorized as 'Vulnerable' (VU) D1 + 2, on account of its restricted distribution. No anthropogenic or grazing effects were observed on the population. Following the criteria laid out by the IUCN (2011), the plant is categorized as 'Vulnerable' (VU) D1, on account of its restricted distribution.

Distribution, habitat and ecology. — *Scilla hakkariensis*, sp. nov., is endemic to eastern Anatolia, Turkey. It is found in the Şemdinli and Çukurca districts of the Hakkari province, that neighbours Iraq (Fig. 3). After a detailed search of some new populations, it might be discovered on the Iraqi border. This species belongs to the Iranian-Turanian floristic region and occurs in rocky areas and clearings of *Crataegus monogyna* Jacq. at altitudes ranging from 890-1070 m above sea level. The habitat of new species mostly included high calcareous soils (Fig. 1E, F). The common species growing in the near vicinity include *Arum rupicola* Boiss., *Bellevalia kurdistanica* Feinbrun, *Crataegus monogyna* Jacq., *Corydalis rutifolia* Boiss. & Buhse, *Eranthis hyemalis* Salisb., *Gagea luteoides* Stapf, *Iris persica* L., *Iris reticulata* M.Bieb. var. *kurdica* Rukšāns, *Lamium amplexicaule* L., *Ranunculus kochii* Ledeb., *Veronica persica* Poir., *Viola odorata* L.

Paratypes. — **Turkey**, C9 Hakkari: Çukurca district, Geliya Tiyar, on rocky areas and rock crevices, 1070 m, 37°17'53"N, 43°40'31"E, fl., 30.III.2012, *M. Fırat 28603*; Şemdinli district, Gelyaşîn region, rocky areas and *Crataegus* crevices 890 m, 37°4'45"N, 44°25'46"E, fr., 17.IV.2014, *M. Fırat 30711*.

Additional specimens. — ***Scilla ingridae*** Speta: **Turkey**, Adana: Saimbeyli, Bozoğlan Dağ, Obruk Yayla, 1450 m, 13.IV.1957, *Davis 26674* (ANK!, E[E00349355]!); Kahramanmaraş: Andırın, Cokak yukarısı yayla yolu üzeri, dere kenarı, 1420 m, 18.IV.2012, *H.Yıldırım 2286* (EGE!); Süleymanlı, Berit Dağı, Çimen yaylası, 2500 m, 11.VI.1978, *B.Yıldız 2040* (AIBU!); Göksun, Kaman Dağı, 1800-2000 m, 20.VI.1981, *B.Yıldız 3015* (HUB[HUB 34614]!); Kayseri: Bakır Dağ at Akoluk Yayla above Kisge, edge of snow, 2000 m, 29.VI.1952, *Davis 19439* (E[E00349362]!); Niğde: Niğde, Aladağlar, Emli Boğazı, 10.IV.2012, *H.Yıldırım 2255*, (EGE!); Torasan Dağı (Aladağlar), kuzey yamaçları, *c.* 2800 m, 1970, *P.Quézel* (ANK!); Ala Dağ, South-west flank of Demirkazık by Arpalık Cave and all raund little Demirkazık, screes by snow, 2400-2800 m, 27.VI.1963, *E.Parry 171* (E[E00349361]!); in the Ala Dağ, on Demirkazık, SW facing stony slope, very close to snow, 28.VIII.1965, *G.W.D.Findlay 121* (E[E00349357]!).

Scilla melaina Speta: **Turkey**, Gaziantep: Nurdağı Geçidi, Aslanlıbeli yukarısı yamaçlar, 1026 m, 11.IV.2009, *H.Yıldırım 1516* (EGE!); Sofdağ, Akçaoba Köyü, 20.III.1981, *A.Baytop 47071* (ISTE!); Hatay: İskenderun, Atik Yaylası üstü, 1045 m, 10.IV.2012, *H.Yıldırım 2253* (EGE!); Dörtyol, Kuzuculu, Keldaz çıkışı, 521 m, 04.IV.2012, *H.Yıldırım 2250*, (EGE!); Amanos, Çardaklı yaylası, *c.* 1400 m, 21.III.1989, *N. Zeybek* (IZEF[IZEF 2220]!); İskenderun, Soğukoluk üstü, Kayalık altları, 12.IV.1981, *H. Malyer 899* (ANK!); Sofdağ'a bağlı Akçaoba köyü, 20.03.1981, *I.Arslanyürek* (ISTF[ISTF47071]!); Belen, Atik, 1000 m, 07.III.1970, *T.Baytop 16472* (E[E00349351]!); Amanus Mts, SE of Dörtyol, lower foothills, rocky slopes in deciduous wood, 500 m, 01.IV.1966, *J.M.Watson 665* (E[E00349350]!); Amanus Mts, Kızıldağ, slopes deep shade of

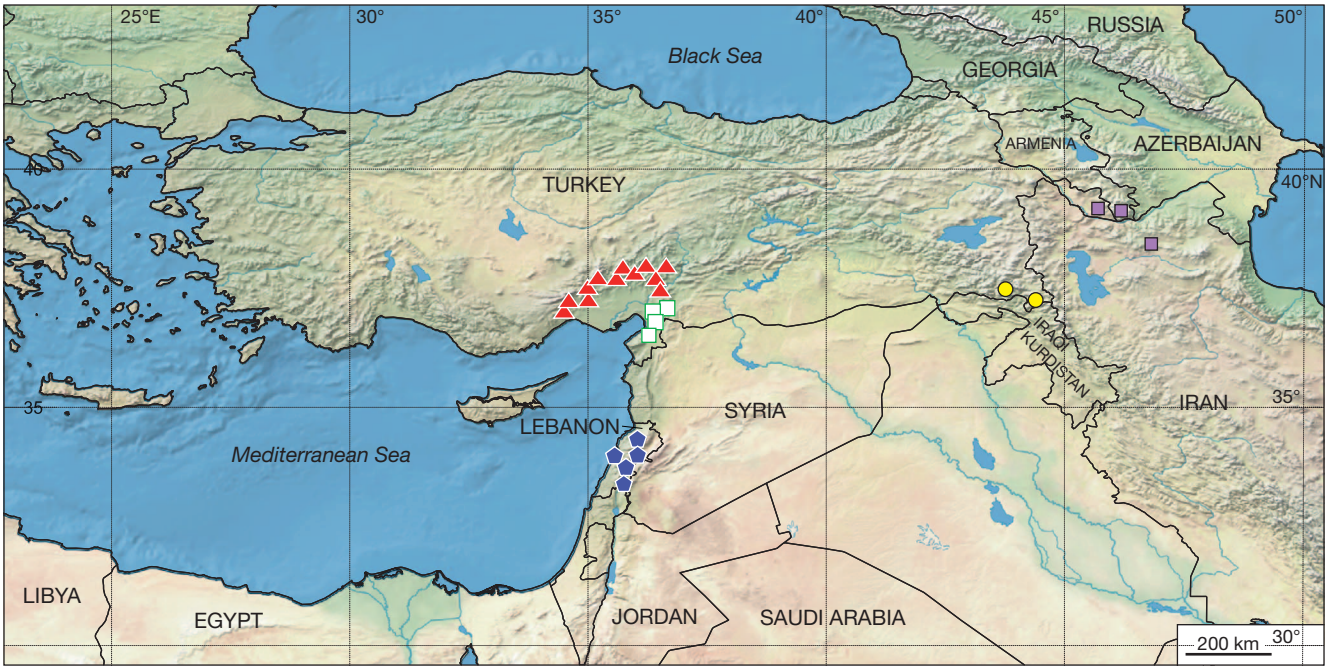

FIG. 3. — The distribution of the *Scilla hakkariensis*, sp. nov., according to herbarium samples: (●), *S. ingridae* Speta (▲) *S. libanotica* Speta (⬟), *S. melaina* Speta (□), *S. mischtschenkoana* Grossh. (■).

Quercus scrub, 1600 m, 10.IV.1967, *A.R.Mitchell 2617* (K!); Amanus Mts, Karlık Tepe above Soğukoluk, hillside limestone, 1250 m, 03.IV.1967 *M.J.Cheese 2502* (K!).

Scilla mischtschenkoana Grossh.: **Azerbaijan**, Distr. Nachitshevan, in monte Sojuch supra oppidum Ordubad, 8000-9000 ft, Culta in sect. cauc., 29.V.1975, *Grossheim* (TBI[TBI1025600]!, E!).

Armenia: Nachrespublica, prope st. viae ferr. Negrom, in calcareis, 29.IV.1933, *T. Heidemann & L. Prilipko* (W!).

Scilla libanotica Speta: **Lebanon**: Hermon; sheltered earthy places under boulders, 12.IV.1959, *O.Polunin 5241* (E!); Above Jezzine, ledges of shady rocks in Quercetum with *Galanthus*, 3300 ft, 14.III.1943, *P.H.Davis 5405* (E!); N. of Jezzin, towards Beit ed Dine, open turf between limestone outcrops and pockets on limestone, 1070 m, 6.III.1966, *J.C.Archibald 1071* (E!); Liban: *M. Labillardière* (G!); Jebel el-Hadid,13.V.1882, 7.IV.1883, *E. Peyron 1754* (G); Merj, 26.IV.1878, *Post 265* (G-Boiss.!); Nebal Hadid, ad nives, V.1882, *E. Peyron* (G-BOISS.!); Antiliban: Quadi el Karn, III.1889, *E. Peyron 942* (G!); Liban sup., III.1891, *Michon* (P[P02058194]!); Ain Zhalta, 9.IV.1934, *P. Mouterde 3146* (P[P02058197]!); Barouk, III.1940, *F. Louis* (P[P02058193]!); Jebel Barouk, vers 1600 m, sous des broussailles près de cèdres, 16.III.1930, *R. Gombault 830* (P[P02058196]!).

DESCRIPTION

Bulb 15-25 × 10-20 mm, subglobose to ovoid; outer tunic membranous, thin texture, pale brown, inner tunic purplish. Leaves 2-5(-7), 4-20 × 0.4-1.3 cm, green, linear, flat, shorter than inflorescence or sometimes equal. Scape 1-3, 3-15 cm long, erect. Inflorescence 2-8 cm long; 1-6-flowered raceme. Bracts minute, triangular or oblong, *c.* 1 mm long, mostly 2-partite, whitish to slightly purplish. Pedicel 3-28 mm long in flower, 5-35 mm in fruit, erect to patent. Perianth whitish to very pale pinkish-blue, mostly pale blue at base of outer surface. Tepal 10-15 × 2-5 mm; midrib concolorous or slightly darker outside, mostly pale bluish. Anthers 2-2.5 × 0.7-1 mm, dark blue; filaments 6-8 mm long, white; pollen grains dark blue to yellowish green. Ovary 2-2.5 × 2-2.5 mm, globose, yellowish-green, 3-locular; style 4-7 mm long, terete, rarely geniculate, whitish; stigma capitate. Capsule 7-10 mm wide, sub-globose. Seeds globose, *c.* 2 mm long, black; surface micropapillate; without ant strophiole or elaiosome.

DISCUSSION

Mordak (1984) used some very variable characters for separation among *Scilla* taxa in Flora of Turkey, such as bract shape, leaf width, or leaf length. But seed morphology is also of high importance (Yıldırım *et al.* 2013, 2014; Yıldırım & Aslan 2015; Yıldırım & Altıoğlu 2017). *Scilla hakkariensis*, sp. nov., shows some morphological similarities to *Scilla libanotica* Speta and *Scilla mischtschenkoana* Grossh. It is easily distinguished from both of them by its whitish to very pale pinkish-blue perianth; shorter style (4-7 mm long); seeds black and without elaiosome or strophiole; shorter and narrower tepal (10-15 mm long, 2-5 mm wide); shorter filaments 6-8 mm long.

On the other hand, *S. hakkariensis*, sp. nov. shows some similarities to *S. ingridae* Speta and *S. melaina* Speta, growing in Turkey. But, it is easily distinguished from *S. ingridae* by its black seed (not yellowish), whitish to very pale pinkish-blue tepals (not sky blue), outer tunic with a thin texture, pale brown (not tough and blackish), leaves flat (not canaliculate); from *S. melaina* by its seeds devoid of elaiosome (not very distinct strophiole on raphe), whitish to very pale pinkish-blue tepals (no dark bluish-purple); leaves without distinct midrib (no distinct grey midrib).

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