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*Allium izmirense* Pirhan, sp. nov. (Amaryllidaceae),  
a new species of *Allium* sect. *Codonoprasum* Rchb.  
from Turkey

Ademi Fahri PİRHAN



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# *Allium izmirensense* Pirhan, sp. nov. (Amaryllidaceae), a new species of *Allium* sect. *Codonoprasum* Rchb. from Turkey

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## ABSTRACT

*Allium izmirensense* Pirhan, sp. nov. (Amaryllidaceae) is described here as a new species. Diagnostic morphological characters, a full description, and detailed illustrations are given herein. *Allium izmirensense* Pirhan, sp. nov. is restricted to Mt. Güme, a part of the Aydın Mountains series near the Tire District of İzmir Province in western Anatolia, Turkey. According to its morphological features, it belongs to *Allium* sect. *Codonoprasum*. It shows morphological similarities to *A. carlstroemi* C. Catt., *A. stamineum* Boiss., *A. armenum* Boiss., *A. tchihatschewii* subsp. *dumanii* (Koyuncu & Koçyigit) Yild., *A. hoshabicum* Firat, and *A. huber-morathii* Kollman, which belong to the same section. *Allium izmirensense* sp. nov. is close related to *A. carlstroemi*. It is easily distinguished from this species mainly by its outer tunic papyraceous; cylindrical and pubescent leaves; leaf sheaths for  $\frac{1}{3}$ - $\frac{1}{2}$  of the stem length; spathe shorter valves 0.5-1.4 cm long, longer valves 1.4-3(-6) cm long; pedicels length 0.5-1.5 cm; tepal pinkish purple, with distinct midrib, length 2.5-3.5 mm; style 2-3 mm long. According to the IUCN criteria *A. izmirensense* Pirhan, sp. nov. is suggested as Critically Endangered (CR) B2ab (ii,iii,v).

## KEY WORDS

Amaryllidaceae,  
pollen morphology,  
seed morphology,  
Izmir,  
western Anatolia,  
new species.

## RÉSUMÉ

*Allium izmirensense* Pirhan, sp. nov. (Amaryllidaceae), une espèce nouvelle d'*Allium* sect. *Codonoprasum* Rchb. de Turquie.

*Allium izmirensense* Pirhan, sp. nov. (Amaryllidaceae) est décrit ici comme une nouvelle espèce. Les caractères morphologiques diagnostiques, une description complète, et des illustrations détaillées sont fournis. *Allium izmirensense* Pirhan, sp. nov. est limité au mont Güme, une partie des monts Aydın, près du district de Tire (province d'Izmir, Anatolie occidentale, Turquie). D'après ses caractéristiques morphologiques, le taxon nouveau appartient à la section *Codonoprasum* du genre *Allium*. Il présente des similitudes morphologiques avec *A. carlstroemi* C. Catt., *A. stamineum* Boiss., *A. armenum* Boiss., *A. tchihatschewii* subsp. *dumanii* (Koyuncu & Koçyigit) Yild., *A. hoshabicum* Firat et *A. huber-morathii* Kollman, qui appartiennent à la même section. *Allium izmirensense* Pirhan, sp. nov. est un proche parent de *A. carlstroemi*. Il se distingue facilement de cette espèce par sa tunique externe papyracée, ses feuilles cylindriques et pubescentes, ses gaines foliaires sur  $\frac{1}{3}$ - $\frac{1}{2}$  de la longueur de la tige, ses spathe à valves courtes de 0,5-1,4 cm de long, à valves plus longues de 1,4-3(-6) cm de long, ses pédicelles de 0,5-1,5 cm de long, son tépale rose pourpre, à nervure médiane distincte, de 2,5-3,5 mm de long, son style de 2-3 mm de long. Selon les critères de l'UICN, *A. izmirensense* Pirhan, sp. nov. est suggéré comme étant en danger critique d'extinction (CR) B2ab (ii, iii, v).

## MOTS CLÉS

Amaryllidaceae,  
morphologie du pollen,  
morphologie des graines,  
Izmir,  
Anatolie occidentale,  
espèce nouvelle.

## INTRODUCTION

The genus *Allium* Linnaeus (1753: 294) is one of the biggest monocot genera, with about 900 species (Govaerts *et al.* 2021). It is spread across the whole northern hemisphere (Stearn 1978, 1992; Fritsch & Keusgen 2006; Friesen *et al.* 2006; Fritsch & Abbasi 2008). After phylogenetical studies, it was evaluated in the family Amaryllidaceae according to APG III (Chase & Reveal 2009). *Allium* is represented by about 220 taxa and 14 sections in Turkey, and nearly of these 90 taxa are endemic (Koçyiğit *et al.* 2016a, b; Koçyiğit & Kaya 2020). Recently, many new *Allium* species have been discovered and described from Turkey and neighboring countries (Galdo *et al.* 2015; Tzanoudakis & Trigas 2015; Ekşi *et al.* 2015, 2016; Koçyiğit *et al.* 2016a, b; Yıldırım 2015; Fırat *et al.* 2017; Özhatay *et al.* 2018; Yıldırım 2019; Ekşi & Yıldırım 2019; Karakuş & Mutlu 2019; Koçyiğit & Kaya 2020; Cattano 2020; Ekşi & Duman 2020). *Allium* sect. *Codonoprasum* Rchb. in Mössler (1827: 538) is the second largest section and is taxonomically very complicated. This section is represented by 57 taxa, of which 26 are endemic to Turkey (Kollmann 1984; Koyuncu 2012; Koçyiğit *et al.* 2016a, b; Koçyiğit & Kaya 2020).

İzmir Province in western Turkey is one of the most species-rich centers of endemism in the Aegean region in Anatolia. During field studies in the framework of the İzmir Biodiversity Project, which was supported by the Ministry of Agriculture and Forestry (Republic of Turkey) in June 2017, a distinct unusual *Allium* population was collected on limestone rocks along the Aydın Mountain range, near the district of Tire in the province of İzmir, which is believed to be new to science.

## MATERIAL AND METHODS

Specimens of the new species were compared with specimens from the ANK, AEF, EGE, E, ISTE, HUB, and K herbaria. The gross morphology of new species and related taxa was examined using a stereo-binocular microscope. Approximately 50 pollen grains and 30 mature seeds were observed using a light microscope and scanning electron microscopy (SEM). For the SEM observations, seed and pollen grains were placed on aluminum stubs using double-sided adhesive tape, sputter coated with gold using an Emiteck K550 sputter coater (Emitech Ltd., Ashford, Kent, UK), and then examined using a Thermo Scientific Apreo S SEM (Thermo Fisher Scientific Inc., Waltham, MA, United States). Images of the living material were taken with a Nikon D300 digital camera (Nikon Corp., Minato City, Tokyo, Japan). The conservation status of new species was evaluated based on the field observations in accordance with the IUCN guidelines (2016). Geographical positions were recorded using a Magellan Explorist 500 handheld GPS device (San Dimas, CA, United States).

## RESULTS

Family AMARYLLIDACEAE J.St.-Hil.  
Genus *Allium* L.

*Allium izmirensense* Pirhan, sp. nov.  
(Figs 1; 2)

*Allium izmirensense* sp. nov. is easily distinguished from *A. carlstroemi* C. Catt. mainly by its cylindrical and pubescent leaves (vs semicylindrical and glabrous), leaf sheaths for  $\frac{1}{3}$ - $\frac{1}{2}$  of stem length (vs  $\frac{1}{4}$ ), 5-20 flowered umbel (vs 6-44 flowered), umbel wide 1-1.5 cm (vs 3-5.5 cm), pedicels length 0.5-1.5 cm (vs 1.7-3.7 cm), flowers campanulate and pinkish purple with distinct midrib (vs conical-campanulate and glossy purplish mauve without distinct midrib), style length 2-3 mm (vs 5.5-6 mm).

TYPE. — Turkey. İzmir: Tire, Aydın Mountain, open mountain slopes, calcareous rocky areas, 38°1'50.37"N, 27°39'22.64"E, 1123 m, 06.VI.2017, A.F. Pirhan & H. Yıldırım 5748 (holo-, EGE!; iso-, EGE!; HUB!; NGBB!).

PARATYPES. — Turkey. İzmir, Tire, Aydın Mountains, open mountain slopes, calcareous rocky areas, 1100 m, 20.07.2017, A.F. Pirhan & H. Yıldırım 6380 (EGE!); 09.05.2019, A.F. Pirhan & H. Yıldırım 3759 (EGE!).

AFFINITY. — *Allium izmirensense* sp. nov. is related to *Allium carlstroemi* C. Catt., *A. stamineum* Boiss., *A. armenum* Boiss., *A. tchibatschewii* subsp. *dumanii* (Koyuncu & Koçyiğit) Yild., *A. hoshabicum* Fırat, and *A. huber-marathii* Kollman. It is especially closely related to *A. carlstroemi*.

FLOWERING TIME. — June.

FRUITING TIME. — June-July.

SEED MORPHOLOGY. — Seeds 2-3 per capsule, 2.1-2.3 × 1.2-1.4 mm, black, ovate to narrow-ovate (Fig. 3). Testa surface has irregular and elongated polygonal testa cells. Periclinal walls bearing several verrucae and mostly one larger central verruca combined with depressed and striate anticlinal walls were also present. Anticlinal walls flat, with irregularly-shaped granules and flat verrucae.

POLLEN MORPHOLOGY. — Pollen grains yellowish, as monads; prolate; exine ornamentation microrugulate and microperforate; equatorial axis (E) roughly 25 to 30 µm long; polar axis (P) roughly 14 to 18 µm wide (Fig. 3).

ETYMOLOGY. — The species epithet is derived from İzmir Province, where the new species was first discovered. The Turkish name of this species is given as “tiresoğanı”, according to the guidelines of Menemen *et al.* (2013).

DISTRIBUTION, HABITAT AND ECOLOGY. — *Allium izmirensense* sp. nov. is a local endemic to the Aydın Mountain range, which extends across both İzmir and Aydın in western Anatolia, and belongs to the element of the Mediterranean floristic region. It colonizes only calcareous rocks above Kaplan Village in the district of Tire, in İzmir (Fig. 4), preferably with an eastern to northeastern orientation, at elevations of 1050-1115 m.

SPECIES CONSERVATION ASSESSMENT. — The new species has a very restricted distribution. The area of occupancy for *Allium izmirensense* sp. nov. was calculated as 0.025 km<sup>2</sup>, in which about 300-350 individuals were estimated to occur. Overgrazing by sheep and goat herds was observed. There was also a high anthropogenic effect on *A. izmirensense* sp. nov. due to the existence of a wind power plant installed within the population. According to the IUCN criteria (IUCN 2016), *A. izmirensense* sp. nov. was evaluated as Critically Endangered (CR) B2ab (ii,iii,v).

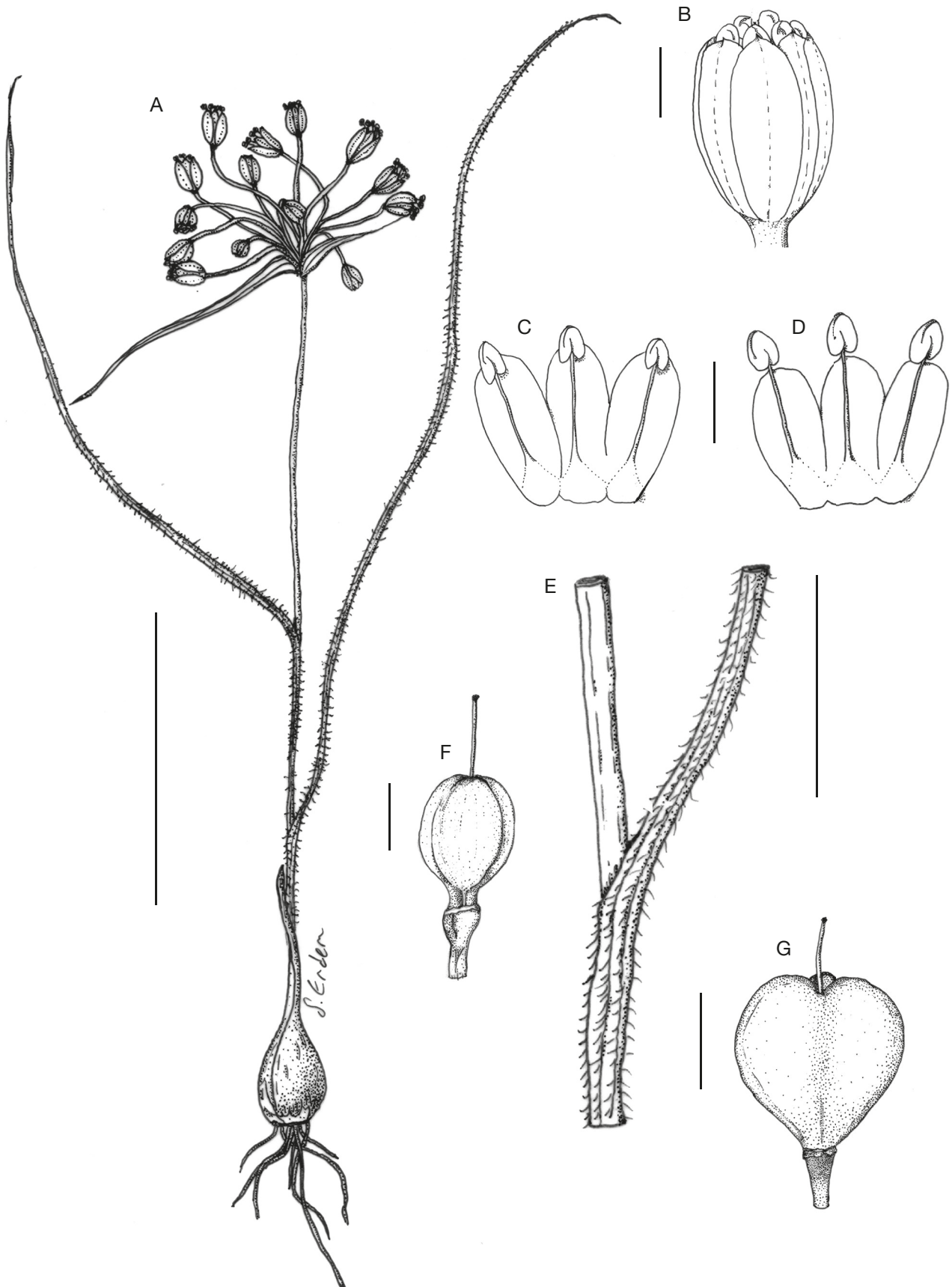


FIG. 1. — *Allium izmirensense* Pirhan, sp. nov.: **A**, habitus; **B**, early stage of flower; **C**, perigone with shorter filaments; **D**, perigone with longer filaments; **E**, details of the sheath; **F**, ovary; **G**, capsule. Drawn by Seval Erden. Scale bars: A, 3 cm; B, F, 1 mm; C, D, G, 2 mm; E, 1 cm.



FIG. 2. — *Allium izmirensis* Pirhan, sp. nov.: A-E, inflorescence; F, blooming; G, individuals in field; H, leaf and leaf sheath indumentum; I, individuals in fruiting stage.

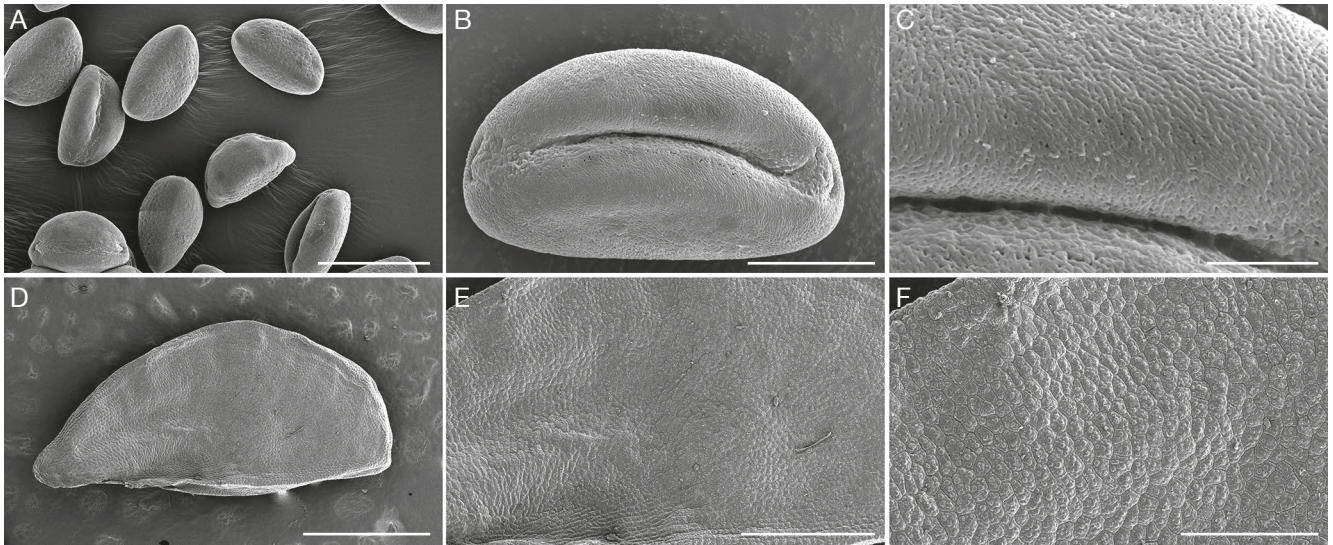


FIG. 3. — *Allium izmirense* Pirhan, sp. nov.: **A, B**, pollen grains; **C**, details of pollen surface in SEM photos; **D**, seed; **E, F**, details of seed testa in SEM photos. Scale bars: A, 30  $\mu$ m; B, 10  $\mu$ m; C, 3  $\mu$ m; D, 1 mm; E, 500  $\mu$ m; F, 200  $\mu$ m.

#### DESCRIPTION

Bulb ovoid to subglobose, 0.6–1.5  $\times$  0.4–1 cm, outer tunics papyraceous, light to dark brown; inner tunic straw colored to very pale pinkish-purple; bulblets absent. Scape 3.5–10 cm long above ground and 1–2 mm wide, erect, terete, glabrous, rarely slightly hairy, greenish, sometimes with slightly purplish tinged, densely punctate cylindrical, 0.6–1 mm in diameter, covered by leaf sheaths for  $\frac{1}{3}$ – $\frac{1}{2}$  of its length; sheaths densely pubescent. Leaves 2–3, fistulose, 4.5–13 cm long, pubescent; hairs very dense at the middle of the leaf, step by step reduced to apex; sometimes near apex glabrous, hairs mostly slightly retrorse-pubescent. Spathe persistent, with two unequal valves, erect to erecto-patent; valves generally longer than umbel, very rarely shorter; the longer valve 1.4–3(–6) cm long, 5-nerved; shorter valve 0.5–1.4 cm long, 3-nerved; attachment opposite. Inflorescence lax, globose to fastigiate, 5–20 flowered; pedicels unequal, 0.5–1.5(–2) cm long, pinkish-purple to purplish; bracts present, membranous; umbel 1–2  $\times$  1–2 cm; bulbil absent. Perigone campanulate, with equal outer and inner tepals. Tepals 2.5–4  $\times$  1.5–2 mm, pale pinkish-purple to whitish-purple, oblong to elliptic-lanceolate, with dark purplish midrib, glabrous, acute at apex. Stamens simple, shorter to slightly exerted tepals; filaments purplish, sometimes whitish at apex, subulate, 2.5–3.8 mm long, connate at base into an annulus *c.* 1 mm high; anthers yellow, ellipsoid, rounded at apex, 0.7–1  $\times$  0.5–0.7 mm. Ovary widely elliptic-globose, greenish, stipitate, 1.5–2–1.5–2 mm; style 2–3 mm long, whitish. Capsule widely obovate to subglobose, 2.5–5  $\times$  2.5–5 mm long, straw colored.

#### DISCUSSION

*Allium izmirense* sp. nov. belongs to *Allium* sect. *Codonoprasum* based on its morphological features. It shows an

affinity to some pinkish to purplish flowered species in this section. *A. izmirense* sp. nov. is related to *Allium carlstroemi* Cattaneo, *A. stamineum* Boiss., *A. armenum* Boiss., *A. tchihatschewii* subsp. *dumanii* (Koyuncu & Koçyigit) Yild., *A. hoshabicum* Firat, and *A. huber-morathii* Kollman.

*Allium izmirense* sp. nov. is especially related to the species *A. carlstroemi*, but it is easily distinguished by its cylindrical and pubescent leaves (vs semicylindrical and glabrous), leaf sheaths for  $\frac{1}{3}$ – $\frac{1}{2}$  of stem length (vs  $\frac{1}{4}$ ), 5–20 flowered umbel (vs 6–44 flowered), umbel wide 1–1.5 cm (vs 3–5.5 cm), pedicels length 0.5–1.5 cm (vs 1.7–3.7 cm), flowers campanulate and pinkish purple with distinct midrib (vs conical-campanulate and glossy purplish mauve without distinct midrib), style length 2–3 mm (vs 5.5–6 mm).

*Allium izmirense* sp. nov. is also easily distinguished from other related species. It differs from *A. stamineum* by its outer tunic papyraceous, light to dark brown and without strips (vs coriaceous, greyish-black, split into strips), scape 3.5–10 cm long (vs 10–50 cm), leaves cylindrical and pubescent (vs semicylindrical and glabrous), spathe shorter valves 0.5–1.4 cm long, longer valves 1.4–3(–6) cm long (vs shorter valves 3–7 cm, longer valves 7–12 cm), umbel 5–20 flowered and 1–1.5 cm wide (vs 25–70 flowered, 3–8 cm wide), pedicel length 0.5–1.5 cm (vs 1–4 cm), tepal length 2.5–3.5 mm (vs 4.5–5.5 mm), ovary stipitate (vs not stipitate); from *A. armenum* by its outer tunic papyraceous, light to dark brown and without strips (vs membranaceous, greyish-black), leaf sheaths for  $\frac{1}{3}$ – $\frac{1}{2}$  of stem length (vs  $\frac{1}{3}$ ), scape 3.5–10 cm long (vs 6–25 cm), cylindrical and pubescent leaves (vs semicylindrical and scabrid), spathe shorter valves 0.5–1.4 cm long, longer valves 1.4–3(–6) cm long (vs shorter valves 0.5–1.5 cm, longer valves 1–2 cm), umbel wide 1–1.5 cm (vs 2–3 cm), pedicel length 0.5–1.5 cm (vs 1–4 cm), tepal

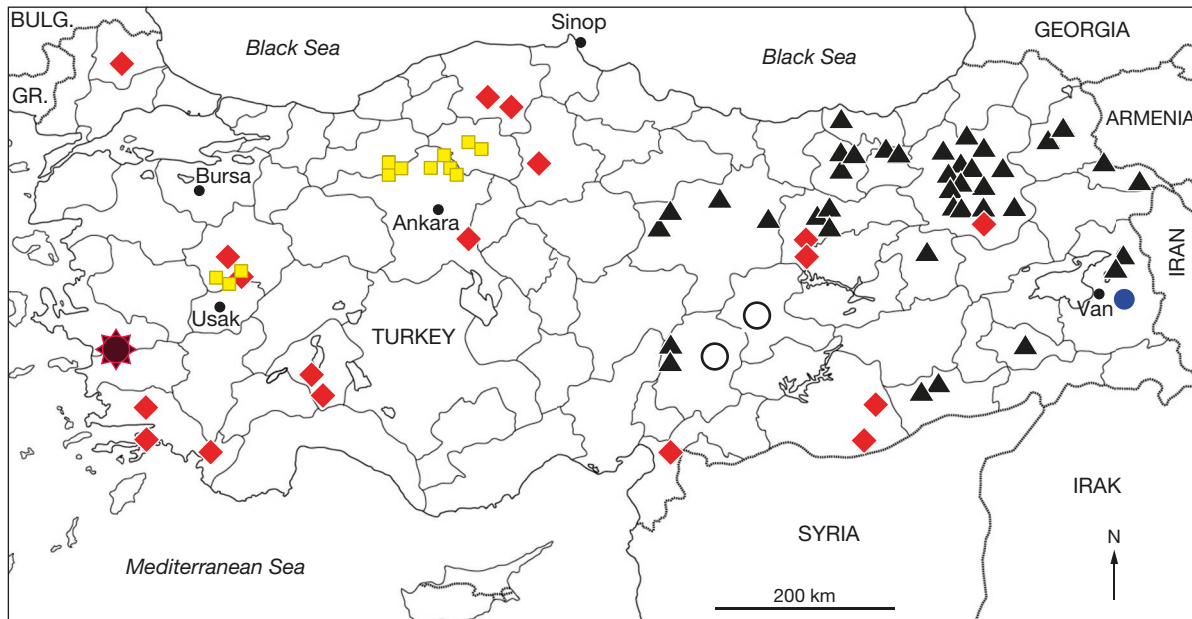


FIG. 4. — Distribution map of *Allium izmirensis* Pirhan, sp. nov. (★), *A. stamineum* Boiss. (◆), *A. armenium* Boiss. (▲), *A. tchihatschewii* subsp. *dumanii* (Koyuncu & Koçyigit) Yild. (○), *A. hoshabicum* Firat (●), and *A. huber-morathii* Kollman (■).

length 2.5-3.5 mm (vs 4.5-5.5 mm), filaments 2.5-3.8 mm long (vs 4.5 mm), ovary stipitate (vs not stipitate), style 2-3 mm long (vs 4-4.5 mm); from *A. tchihatschewii* subsp. *dumanii* by its outer tunic light to dark brown (vs greyish-brown leaf sheaths for  $\frac{1}{3}$ - $\frac{1}{2}$  of stem length (vs  $\frac{1}{2}$ - $\frac{2}{3}$ ), leaves pubescent (vs glabrous), spathe longer valves 1.4-3(-6) cm long (vs 0.6-1 cm), pedicel length 0.5-1.5 cm long (vs 0.3-0.6 cm), tepal pinkish purple, with distinct midrib (vs purplish mauve, midrib not distinct), anther yellow (vs purple), style 2-3 mm long (vs 3-4 mm); from *A. hoshabicum* by its outer tunic light to dark brown and without strips (vs membranaceous, blackish-grey, split into strips), leaf sheaths for  $\frac{1}{3}$ - $\frac{1}{2}$  of stem length (vs  $\frac{1}{2}$ - $\frac{2}{3}$ ), leaves pubescent (vs glabrous), spathe shorter valves 0.5-1.4 cm long, longer valves 1.4-3(-6) cm long (vs shorter valves 1-2 cm longer valves 1-2 cm), umbel wide 1-1.5 cm long (vs 2.5-3 cm), tepal length 2.5-3.5 mm (vs 4-4.5 mm), filaments 2.5-3.8 mm long (vs exerted, 4-4.5 mm), ovary elliptic-globose (vs cylindrical-ovate), style 2-3 mm long (vs 3-6 mm); from *A. huber-morathii* by its outer tunic papyraceous, light to dark brown and without strips (vs coriaceous, black or greyish-brown), scape 3.5-10 cm long (vs 10-25 cm), leaf sheaths for  $\frac{1}{3}$ - $\frac{1}{2}$  of stem length (vs to  $\frac{1}{3}$ ), cylindrical and pubescent leaves (vs semicylindrical and scabrid), spathe shorter valves 0.5-1.4 cm long, longer valves 1.4-3(-6) cm long (vs shorter valves 0.5-1 cm, longer valves 1-2 cm), umbel wide 1-1.5 cm (vs 2.5-3 cm), pedicel length 0.5-1.5 cm (vs 1-2 cm), tepal length 2.5-3.5 mm (vs 4-4.5 mm), filaments 2.5-3.8 mm long (vs 4-4.5 mm), style 2-3 mm long (vs 4-4.5 mm). Detailed morphological differences between the new species and other related *Allium* species are summarized in Table 1.

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TABLE 1. — Comparison of selected characters differing among *Allium izmirensense* Pirhan, sp. nov., *A. carlstroemi* C. Catt., *A. stamineum* Boiss., *A. armenum* Boiss., *A. tchihatschewii* subsp. *dumanii* (Koyuncu & Kocyigit) Yild., *A. hoshabicum* Firat and *A. huber-morathii* Kollman.

Features	<i>Allium izmirensense</i> sp. nov.	<i>Allium carlstroemi</i>	<i>Allium stamineum</i>	<i>Allium armenum</i>	<i>Allium tchihatschewii</i> subsp. <i>dumanii</i>	<i>Allium hoshabicum</i>	<i>Allium huber-morathii</i>
Outer tunic	papyraceous, light to dark brown	coriaceous, dark brown	coriaceous, split into strips, Greyish-black	membranaceous, greyish-black	papyraceous, greyish-brown	papyraceous, blackish-grey, split into strips	coriaceous, black or greyish-brown
Scape	3.5- 10 cm	5-14 cm	10-50 cm	6-25 cm	5-10 cm	7-15 cm	10-25 cm
Leaf shape	cylindrical	semicylindrical	semicylindrical	semicylindrical	cylindrical	cylindrical	semicylindrical,
Leaf sheath	1/3-1/2	1/4	1/3-1/2	to 1/3	1/2-2/3	1/2-2/3	to 1/3
Leaf indumentum	pubescent	glabrous	glabrous	scabrid	glabrous	glabrous	scabrid
Spathe valves	shorter 0.5-1.4 cm, longer 1.4-3(-6) cm.	shorter 0.95-2 cm, longer 1.3-2.4 cm	shorter 3-7 cm, longer 7-12 cm	shorter 0.5-1.5 cm, longer 1-2 cm	shorter 0.5-0.8 cm, longer 0.6-1 cm	shorter 1-2 cm, longer 1-2 cm	shorter 0.5-1 cm, longer 1-2 cm
Inflorescence	5-20 flowered	6-44 flowered	25-70 flowered	5-20 flowered	14-20 flowered	5-20 flowered	5-20 flowered
Umbel width	1-1.5 cm	3-5.5 cm	3-8 cm	2-3 cm	1-1.5 cm	2.5-3 cm	2.5-3 cm
Pedicel length	0.5-1.5 cm	1.7-3.7 cm	1-4 cm	1-2 cm	0.3-0.6 cm	5-15 mm	1-2 cm
Perigon shape	campanulate	conical	conical	campanulate	shortly campanulate	campanulate	campanulate
Tepal colour	pinkish purple; with distinct midrib	glossy purplish-mauve; midrib indistinct	greenish-yellow tinged with purple	purple, pinkish purple,	purplish-mauve	pinkish purple with darker midvein	pinkish purple
Outer Tepal	2.5-3.5 × 1.5-3 mm	4 × 2 mm	4.5-5.5 × 2-2.5 mm	4-4.5 × 1.7-2 mm	2.5-3 × 0.8-1 mm	3.5-4 × 1.5-2 mm	4-4.5 × 1.5-2 mm
Stamens	inside to slightly exerted; filaments length 2.5-3.8 mm	slightly exerted; filaments length 4.5 mm	exserted; filaments length 4-6.5 mm	exserted; filaments length 4.5 mm	exserted; filaments length 3.5 mm	exserted; filaments length 4-4.5 mm	exserted; filaments length 4-4.5 mm
Anther	yellow	yellow	yellow	purple	purple	yellow	purple
Style length	2-3 mm	5.5-6 mm	2-2.5 mm	4-4.5 mm	3-4 mm	3-6 mm	4-4.5 mm,
Ovary	elliptic to globose stipitate	subglobose stipitate	subglobose	globose	ovoid-globose stipitate	cylindrical-ovate stipitate	globose short stipitate
Habitat	in limestone-rich soils resulting from the rock outcroppings; c. 1000 m a.s.l.	in limestone-rich soils resulting from the rock outcroppings; c. 340 m a.s.l.	dry, rocky slopes; 0-400 m.	dry, rocky slopes; 900-2400 m	scree, mountain slopes; 2000-2300 m.	dry steppe; 2700-2800 m.	dry, rocky slopes; 0-400 m.

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