THE SYNOPSIS OF THE SECTION COMPACTOPRASON (AMARYLLIDACEAE, ALLIOIDEAE) IN UZBEKISTAN

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Annotation. The genus Allium, part of the Amaryllidaceae family, is well-known for its ecological, culinary, and medicinal importance, with key species such as Allium sativum (garlic) and Allium cepa (onion) playing vital roles in global agriculture and human health. This study examines the distribution and ecological characteristics of four Allium species (A. giganteum, A. majus, A. komarovii, and A. macleanii) across Central Asia, particularly in Uzbekistan. These species exhibit distinct environmental preferences, with A. giganteum showing broad adaptability to various altitudes and geographic regions, while species like A. majus and A. macleanii are more restricted in their distribution, highlighting their specialized habitat requirements. This research also focuses on the subgenus Melanocrommyum, particularly the Compactoprason section, which is characterized by unique floral structures and reproductive strategies, including large, densely packed inflorescences with over 3,000 flowers. The study utilizes field expeditions (2019–2024), herbarium specimens, and advanced mapping tools such as ArcGIS and Google Earth to analyze species distribution and temporal changes. Findings emphasize the need for targeted conservation efforts, especially for species with limited distribution ranges. This research contributes to a deeper understanding of the biodiversity of Allium species in Central Asia, particularly those in Uzbekistan, and underscores the ecological and taxonomic significance of the Compactoprason section within the broader subgenus Melanocrommyum.

Keyword: Allium, Allium sativum (Garlic), Allium cepa (Onion), Biodiversity, Ecological Distribution, Central Asia, Uzbekistan, subgenus Melanocrommyum, section Compactoprason, Inflorescence structure

Introduction

The genus Allium, a prominent member of the family Amaryllidaceae, is globally recognized not only for its culinary and medicinal significance but also for its extensive biodiversity. Among its species, Allium sativum (garlic) and Allium cepa (onion) are of particular importance, serving as essential agricultural crops that shape food culture and human health worldwide (Friesen, 2022). Allium species are predominantly distributed across the Northern Hemisphere, thriving especially in temperate regions of Europe, Asia, and North America. With over 1000 species described, Allium exhibits remarkable morphological diversity, and is classified into 15 subgenera and 85 sections (Friesen et al., 2006; Li et al., 2010).

A critical subgenus within Allium is Melanocrommyum, first described by Webb & Berthelot and later refined by Rouy. This subgenus is significant not only for its large number of species over 160 but also for its substantial ecological and morphological variability. Melanocrommyum is divided into 21 sections, making it the second-largest subgenus in Allium (Friesen et al., 2021). In Uzbekistan, a rich diversity of Allium species can be found, particularly those belonging to the subgenus Melanocrommyum. To date, 46 taxa from 13 sections have been recorded in the region (Fritsch 2016). Among these, the section Compactoprason stands out due to its unique characteristics and its notable representation in Uzbekistan, with four out of the six recognized species in this section growing in the region (Khassanov et. al. 2017).

The section Compactoprason is distinctive from other sections of Allium in a variety of ways, particularly in terms of its inflorescence structure. Unlike the typical inflorescences seen in other sections such as those in the subgenus Brevicaule, which typically contain 20 to 50 flowers Compactoprason species often form cymose pseudoumbels with numerous, densely packed helicoid or scorpioid cymes. These

inflorescences can contain over 3000 individual flowers, making them significantly larger in floral count than those of most Allium sections. Another key feature of Compactoprason is the low number of ovules per locule, with an average of only 2, in stark contrast to the 4–7 ovules typically found in other sections, and as many as 24 in some species. In terms of reproductive strategies, the capsules of Compactoprason species are characterized by a narrow dehiscence, and unlike many other Allium species where capsules open widely to release seeds via wind or movement, the capsules of Compactoprason often detach entirely from the pedicels when ripe, dropping to the ground intact (Fritsch, 2012).

In addition to its floral and reproductive characteristics, the section Compactoprason is further differentiated by a combination of morphological traits, including a dull scape and a coarse, dull ovary surface. The inflorescences of Compactoprason species also exhibit noticeably unequal pedicels, distinguishing them from other closely related sections such as Procerallium and Regeloprason (Fritsch, 2012). These unique features underscore the ecological and taxonomic importance of the Compactoprason section within the broader subgenus Melanocrommyum and its relevance to the flora of Uzbekistan.

This research sets the stage for a deeper understanding of Allium species in Central Asia, with a specific focus on the Compactoprason section, its distinctive morphological traits and its relevance to the botanical diversity of Uzbekistan.

Materials and Methods

Fresh plant materials collected in Uzbekistan during field expeditions from 2019 to 2024, along with herbarium specimens, were studied using the virtual platforms of individual herbaria, particularly those housed at the National Herbarium of Uzbekistan (TASH). Species distribution ranges and some morphological characteristics were compared with earlier reports by Fritsch (2016) and Khassanov (2017). Descriptions of the subgenus Melanocrommyum species occurring in the flora of Uzbekistan were compiled based on Khassanov’s work (2017), with further modifications and updates based on the authors' own observations of fresh specimens in the wild and herbarium materials.

Additional insights from Fritsch (2016), who had also examined live specimens during botanical fieldwork, were incorporated. Species identification was verified using original species descriptions (protologues) and other relevant literature (Fritsch 2016; Khasanov 2007; Khassanov & Yusupov 2022). ArcGIS software (version 10.8.1), obtained from the official ESRI website (https://support.esri.com/en/Products/Desktop/arcgis-desktop/arcmap, accessed on 1 March 2023), was used for mapping, with the base map provided by the National Meteorological Information Center. Herbarium data were first compiled in Excel, georeferenced, and then transformed into point layer maps in ArcGIS. Google Earth was used to georeference the historical specimen collection sites. The WGS84 coordinate system was employed as a geographic reference. To assess temporal changes in distribution, two separate maps were created for each species: one for records before 1970 and one for records after 1970, helping to illustrate trends in population decline, growth, or shifts in sampling focus over time.

Results and Discussions

Sect. Compactoprason R.M. Fritsch in Hanelt et al. (Eds), The genus Allium: taxonomical problems and genetic resources: 156(1992).

Type:—A. giganteum Regel., Gartenflora: 91(1883).

Identification key for Melanocrommyum sect. Compactoprason

1a. Bulbs ovoid or ovoid-spherical, scape 60-150 cm…….……2

1a. Bulbs spherical, scape 30-100 cm……..……...3

2a. Bulb shells are leathery, splitting. The tepals are elliptical, 5–6 mm long…… **A. giganteum**

2b. Bulb shells are papery. Tepals narrowly triangular, 6–7.5 mm long. **A. macleanii**

3a. The spathe is equal to umbel, Umbel spherical, tepals are light purple, with a darker or greenish vein, 5 mm long, elliptical, obtuse, Ovary almost sessile…… **A. majus**

3b. The spathe is 1.5 times shorter than umbel, Umbel hemispherical, tepals are dark lilac with a darker vein, linear-lanceolate, 6 mm long, Ovary distinctly stipitate……..……...

A. komarowii

1. Allium giganteum Regel., Gartenflora: 91(1883).

Type:—Ex horto bot. Petropolitano 82.6 Allium giganteum Regel, two inflorescences on the left side, (lectotype LE; designated by Fritsch et al. 2010: 205).

Description:— Bulb ovoid, 4–6 cm thick, with rather numerous, gray-brown, leathery, splitting tunics. Scape straight, strong, 80–150 cm high. Leaves are belt-shaped, gray, 5–10 cm wide, smooth, 2–3 times shorter than the scape. The scape is two times shorter than the umbel, with a short nose. Umbel spherical, many-flowered, dense. Pedicels almost equal, 5 or more times longer than an umbel, without bracts. Perianth stellate; tepals are light purple with an inconspicuous vein, 5 mm long, elliptical, obtuse, not changing after flowering. Filaments 1.5 times as long as perianth, fused at base with each other and with perianth, subulate from triangular (in inner stamens 1.5 times wider) bases. Ovary almost sessile, rough. The capsule is almost spherical, 4 mm in diameter.

Phenology:—Flowering. April-May.

Ecology:—Soft slopes in the lower belt of mountains, at an altitude of 800–1500 m.

Distribution area:—Iran, Afghanistan, Central Asia (Kopetdag, Pamir-Alay): Tajikistan, Turkmenistan, Uzbekistan.

Specimens examined:—UZBEKISTAN: Baysun expedition. okr. spring Dzhida-bulak. On gypsum rocks, 5 May 1941, Popova 402 (TASH); Variegated lowlands between Baysun and Denau. okr. Khodja-ipak source. Rubble slope in limestone, 19 May 1930, Bochantsev, Vvedensky 820 (TASH); Variegated lowlands between Baysun and Denau. okr. winter Tashkak. Crest, 26 May 1930, Bochantsev, Vvedensky 343 (TASH); Hissar ridge. Bass. R. Sangardak. On the way along the river Khandiza from c/c Degi-Surkh, June 1948, Pyataeva 346 (TASH); Surkhandarya region 4 km to the N from the mark 3115 near the river. Obi-Zarang. NE slope, 6 July 1966, Kamalov s.n. (TASH); Pamir-Alai.

Variegated low mountains to the SE from Guzar. Sev. The slopes of the gorge. Kizil-kiya in the Jety-ogul mountains, 6 May 1935, Gnestdillo 77 (TASH); Pamiroalai. Babatag mountains. Ukhlov tract, 2 May 1940, Bukasov 163 (TASH); Babatag forestry. Chagam forestry. Umergen-bulak-sai, 26 August 1964, Filimonova 943 (TASH); Baysun mountains, ok. k. Amankhana, 26 October 2011, O. Turginov s.n. (TASH); Baysun mountains, on the road from Baysun to Shurchi. 15-20 km from Baysun, near a mineral spring, on an adjacent slope, 5 May 2007, Tojibaev s.n. (TASH); Babatag ridge. Babatag mountains, along the Denov and Chagam road 26 May 2021, Pulatov S., Dekhkonov D., Makhmudzhanov D. DDS26032021021 (TASH); Surkhandarya, 25 May 2019, Turginov 19_TO01 (TASH); Bass. R. Macai, kish. Yukari Machai, uroch. Sharshara, rocky substrate slope, 26 May 2020, Pulatov S., Juramurodov I., Jabborov A., Rakhmatov A., Makhmujanov D., Madaminov F. 26052020690 (TASH);

2. Allium macleanii J.G. Baker in Bot. Mag. 109: t. 6707 (1883).

Type:—Cultivated material. Bulb brought from Cabul by Colonel Maclean (holotype K).

Description:—Bulb ovoid-spherical, 2–6 cm thick, with blackish papery tunics. Scape 60–100 cm high, smooth. Leaves 2–6 (8) in number, oblanceolate, 2–7 cm wide, smooth along margins. The spathe is 1.5 times shorter than the umbel. Umbel spherical, many-flowered, dense. Pedicels equal, 3–8 times as long as perianth, without bracts. Perianth stellate; tepals are beautifully purple with an inconspicuous darker vein, 6–8 mm long, linear-lanceolate, acute or obtuse, not changing after flowering. The filaments are slightly longer than the perianth, fused at the base with each other and with the perianth, subulate from a triangular (in the inner stamens 1.5 times wider) bases. Ovary sessile, rough.

Phenology:—Flowering. June-July.

Ecology:—On rocky slopes in the lower and middle belt of mountains at an altitude of 800–1600 m.

Distribution area:—India, Pakistan, Afghanistan, Central Asia (Pamir-Alai): Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan.

Specimens examined:—UZBEKISTAN: SW spurs of the Hissar Range, Baysun-tau mountains. Machai river valley, right bank. okr. c/c Urtamachai, variegated flowers, 23 May 1978, Nabiev, Lee, Zukervanik 655 (TASH); Hissar Range, bass. R. Lyangar, Aksu river valley, between the k / k Kyzyl kishlak and Kyzyl Mechet, at the outcrops of variegated rocks - 3 specimens, 14 May 1972, Nabiev, Shermatov, Kazakbaev 48 (TASH); Southern Pamiroalai, Mt. Kugitang, 7 km south of Aktash, limestone, 9 May 1989, Kamelin, Khasanov 307 (TASH); Tien Shan. Kuraminsky ridge. Uigursay, 563 m, 24 May 2009, F.O. Khasanov, K.Sh. Tojibaev s.n. (TASH).

3. Allium majus Vved. in FI. Uzbekistan. 1:543 (1941).

Type:—UZBEKISTAN. Western Pamir-Alay, Upper part of Yakkabag river basin, nearby village Tashkurgan, stony slopes to the river (in Russian), 2 July 1936, Botschantzev, Butkov, 576 (holotype TASH).

Description:—Bulb spherical, 3–5 cm thick, with dark gray, papery, fissile tunics. The scape is straight, strong, 1 m high, smooth. Leaves are broadly oblanceolate, glaucous, 4–8 cm wide, smooth, 3 times shorter than the scape. The spathe is equal to umbel, pointed. Umbel spherical, many-flowered, dense. Pedicels almost equal, many times longer than perianth, without bracts. Perianth stellate; tepals are light purple, with a darker or greenish vein, 5 mm long, elliptical, obtuse, recurved downwards after flowering, twisting, internal slightly wider. The filaments are equal to the perianth, at the base fused with each other and with the perianth, above each other soldered into a ring, from a triangular (in the inner stamens 3 times wider) subulate bases. Ovary almost sessile, rough.

Phenology:—Flowering. May-June.

Ecology:—Stony and variegated slopes of the middle belt of mountains at an altitude of 1300–2000 m.

Distribution area:—Endemic of Uzbekistan (Western Pamir-Alai).

Specimens examined:—UZBEKISTAN: 18 km from the village of Langar to the south. 1.5 km from the village of Kok-bulak, on red variegated flowers in a sparse juniper forest,

25 June 1954, Gringoff 747 (TASH); 15 km to the South from the c / c Lyangar on the road to Kok-Bulak, 2 km from the village of Kok-bulak, in juniper forests, 25 June 1954, Pyataeva 706a (TASH); Mountains to E of Yakkabag. To the south from k / k Kipchak, red screes, 1 July 1927, Kultiasov, A. Granitov 785 (TASH); Bass. R. Kashkadarya, Kyr-tau, Scree, 1300 m, 24 April 1991, F. Khasanov s.n. (TASH); Southwestern spurs of the Hissar Range, bass. R. Kyzyl-Darya, 2 km south of Tashkurgan 2 specimens, 20 July 1991, Khasanov, Maltsev s.n. (TASH); Outcrops of variegated rocks and talus on the northern slope of the Hissar Range in the basin of the river. Aksu in the vicinity of the village of Gissarak, about 1300, 1 July 1927, Kultiasov, Granitov s.n. (TASH); mountains to E of Yakkabag, Kipchak, 1 July 1927, Kultiasov, Granitov 785 (TASH); Infertility. Uzbekistan, Kashkadarya region, southern slope of the Zeravshan Range, upper reaches of the river. Kashkadarya is above the village of Hazrat-Bashir, on a steep rocky slope, 21 June 2018, Western Pamir-Alai. The upper reaches of the river Yakkabag-darya. okr. kish. Tash-Kurgan. Fine earth-gravelly slopes to the river, Yakkabag-Darya in kish. Tash-Kurgan, 22 July 1936, Botschantzev, Butkov 576 (TASH).

4. Allium komarowii Lipsky in Trudy Imp. S.-Peterburgsk. Bot. 18:129 (1901).

Type:—Flora Seravschanica, Iskandcrkul (in Russian), 7000', Juniperus zone, 18.98, Komarov (lectotype LE; designated by Fritsch 1990: 505).

Description:—The bulb is spherical, 2–4 cm wide. Scape 30–50 cm high. Leaves 1–2 in number, broadly lanceolate or oblong, 4–8 cm wide, smooth, pointed along the edge, much shorter than the scape. The spathe is short-pointed, 1.5 times shorter than umbel. Umbel hemispherical, many-flowered, dense. Pedicels equal, 2–3 times as long as perianth, without bracts at base. Perianth stellate; tepals are dark lilac with a darker vein, linear-lanceolate, 6 mm long., obtuse, later bent down, twisted. Filaments longer than the perianth, fused with it at the base, higher soldered together in a ring, from a triangular (at the inner stamens 2 times wider) base gradually subulate. Ovary on a short stalk, rough. The capsule is almost spherical, 6 mm in diameter.

Phenology:—Flowering. May-June.

Ecology:—Screes in the middle belt of mountains at an altitude of 1600–2100 m.

Distribution area:—Central Asia (Pamir-Alai): Tajikistan, Uzbekistan.

Specimens examined:—UZBEKISTAN: Zarafshan ridge, Navi-Daraz, in the sai between the stones, 27 May 1987, Faiziev s.n. (TASH); Turkestan Ridge, Zaamin forestry, Guralash river gorge, left source of Guralash, 26 July 1926, Popov, Androsov 164 (TASH); Pamir-Alai. Turkestan ridge. Guralash river basin. The pass from Guralash to the c / c Langar, 13 July 1935, Zakrzhevsky 918 (TASH); The western part of the Turkestan ridge. (People's Park), Almaly creek and up the creeks, 27 May 1979, J. Volozheninov s.n. (TASH); Turkestan range, bass. R. Zaamins. Zaamin National Park, lower reaches of the river. Urikli, the eastern slope below the sanatorium, on the scree, 1400 m, 8 May 2014, Tojibaev s.n. (TASH); Hissar ridge. (Zarafshan ridge), Kitab reserve, left bank of the river. Garlyka, scree, 1700 m, 14 July 1987, Soldatova 46 (TASH); Kitabsky reserve, starboard side of the x. Khutana in the upper reaches, 2000 m, 5 July 1987, Soldatova 25 (TASH); Turkestan ridge, upper reaches of the Kashka-Su river., 6 June 2020, Ortikov E., Pulatov S., Turdiev D., Juramurodov I., Makhmudjanov D. A 6062020174 (TASH).

The figure 1 illustrates the distribution of four Allium species (Compactoprason) A. giganteum, A. majus, A. komarovii, and A. macilentii across the Central Asian region, spanning parts of Uzbekistan, Turkmenistan, Tajikistan, Kyrgyzstan, and Afghanistan. The data presented reveals species-specific preferences for altitude and geography, with each species occupying distinct environmental niches. Allium giganteum appears to be the most widely distributed species, with populations present across a broad range of elevations and geographic regions. This suggests that A. giganteum may have a higher ecological adaptability, thriving in both lowland and high-altitude environments. In contrast, A. majus is more geographically restricted and appears to be confined to certain altitudes, possibly reflecting a specialized habitat preference that may be related to soil type or microclimatic conditions. Allium komarovii has a distribution pattern similar to A. giganteum, although it shows a stronger concentration in specific regions and altitudes, suggesting a preference for particular environmental conditions. On the other hand, A. macleanii is predominantly

found at higher elevations, which suggests that this species is adapted to more mountainous, cooler environments with stable climatic conditions. These patterns are consistent with known ecological trends for Allium species in Central Asia. It is noted that altitude and climate are crucial factors in determining the distribution of Allium species in the region. Species like A. giganteum, which are found in a wider range of environments, are likely to possess greater ecological plasticity, allowing them to adapt to various soil types, temperature ranges, and moisture levels. In contrast, species with more restricted distributions, such as A. majus and A. macleanii, may be more vulnerable to environmental changes, particularly those related to climate change and habitat fragmentation. Further studies focusing on the genetic diversity, soil composition, and specific climate conditions of the regions where these species thrive will be crucial in understanding the ecological strategies that enable their survival in such diverse environments. These findings also emphasize the need for targeted conservation efforts, especially for species like A. majus and A. macleanii, which may be more susceptible to habitat loss due to their restricted ranges and specialized habitat needs (Khassanov, 2017).

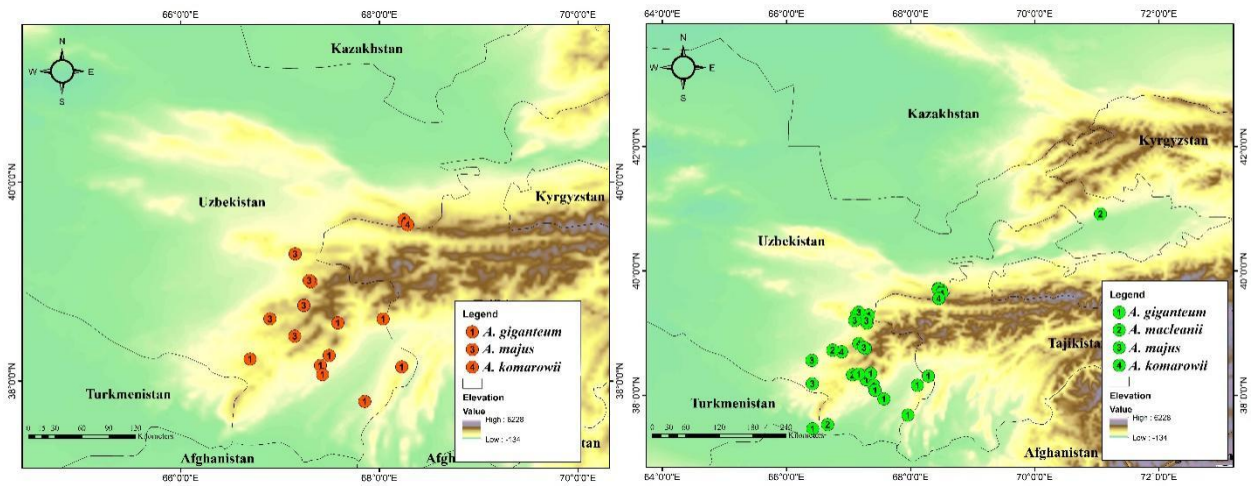

Fig.1. Distribution of the species of sect. **Compactoprason** before (A) and after (B) the year 1970.

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