



## *Iris zagrica* subsp. *penjwenica*; *Iris zagrica* subsp. *warteica*; two new subspecies from the Iraqi Kurdistan region belonging to *Iris* section *Zagrica*

Hoshman Omar Majeed <sup>1\*</sup>, Rubar Hussein Muhammed Salih<sup>2</sup>

<sup>1</sup>Department of Horticulture, College of Agricultural Engineering Sciences, University of Sulaimani, Sulaimani, Kurdistan Region, Iraq.

<sup>2</sup>Department of Biotechnology and Crop Science, College of Agricultural Engineering Sciences, University of Sulaimani, , Sulaimani, Kurdistan Region, Iraq.

Received 30 July 2023; revised 02 November 2023;  
accepted 03 November 2023; available online 12 November 2023

DOI: 10.24271/PSR.2023.409295.1357

### ABSTRACT

Subgenus *Hermodyloides* Spach is one of the most attractive groups of ornamental plants belonging to the family (*Iridaceae* Juss). In Iraq, this subgenus comprises two sections, which are *Reticulata* and *Zagrica*. Section *Zagrica* is represented by species *Iris zagrica* Mathew & Zarrei. In this study, plants were collected from two different locations in the Sulaymaniyah (MUS) and Erbil districts of the Kurdistan Region-Iraq. After plant Identification and comprehensive morphological and palynological study, two new subspecies, *Iris zagrica* subsp. *warteica* and *Iris zagrica* subsp. *penjwenica* were reported for the first time to the vascular flora of the Iraqi Kurdistan region, which is collected from the Penjwen subdistrict and Zine-Warte from Warte subdistrict. Here; the detailed morphological characteristics, palynological study, and geographical distribution of these subspecies are acknowledged.

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**Keywords:** *Hermodyloides*, *Iridaceae*, *Iris zagrica*, *Morphology*, *Reticulate Iris*, *Kurdistan Region*, *Iraq*.

### 1. Introduction

*Iris* is a genus that includes more than 300 species in the *Iridaceae* family<sup>[1, 2]</sup>. The greatest of which are native to temperate regions of the northern hemisphere<sup>[2]</sup>. The bearded iris, also known as *Iris germanica*, is widely cultivated for its ornamental value<sup>[1, 3-4]</sup>. Plants of the genus *Iris* are known for their distinctive flowers, there are three petals and three sepals on each flower, and they can be found in a wide range of colors, including blue, purple, yellow, and white<sup>[4-6]</sup>. Depending on the species and the climate, these plants usually bloom in spring or early summer. There are many horticultural uses of this genus, including indoor as well as outdoor plants, and some of the flowers are used as cut flowers<sup>[7-9]</sup>. In addition to their ornamental value, some species of *Iris* have been used for medicinal purposes, and the dried rhizomes of certain species are used in perfumes and cosmetics<sup>[10-12]</sup>. *Iris* plants are also a popular subject in art and literature and have been associated with various symbolic meanings throughout history<sup>[13, 14]</sup>.

Section *Zagrica* recently applied to the flora of Iraq by Majeed<sup>[15]</sup>, including some individuals collected from different locations in Iraq. In the Majeed study confirmed the taxonomical status of the subgenus *Hermodyloides* for the first time in Iraq using

molecular and morphometric studies. However, the status of these individuals within the subgenus above as a new record has not been confirmed yet. So, the present study aims to identify these plants both from Ziny-Warte and Penjwen and provide a correct name for the first time.

### 2. Methods and Materials

#### 2.1 Plant Materials

Sixty samples were collected from two different locations in the Sulaymaniyah (MUS) and Erbil districts of the Kurdistan Region-Iraq. Penjwen is about 73 km East of Sulaymaniyah city, and Warte is about 120 km from Erbil, and 200 km north of Sulaymaniyah city. Global Position System (GPS) data (mentioned in sections 3.1 and 3.2) was recorded and used for drawing a geographical map. Further, the study examined the above resources and herbarium (SUFA- Sulaimani University, Faculty of Agriculture) specimens to determine the distribution, location, and flowering time of *Iris* species in the MSU and Erbil districts. The conservation status of the new species was assessed according to the IUCN criteria<sup>[16]</sup>.

#### 2.2 Species identification

Species identification was performed using different resources, including flora Iranica<sup>[17]</sup>, flora of Turkey<sup>[18]</sup>, and flora of Iraq<sup>[2]</sup>, in addition to available published papers and research such as Mathew and Zarrei, Firat, and Moat et al.<sup>[19-21]</sup>. Twenty to thirty

\* Corresponding author

E-mail address: [hoshman.majeed@univsul.edu.iq](mailto:hoshman.majeed@univsul.edu.iq) (Instructor).

Peer-reviewed under the responsibility of the University of Garmian.

plants underwent a comprehensive morphological study. A full photographic record of the morphological organs and parts of the plants was performed. Morphological measurements were also performed from fresh material by using digital calipers to measure the floral parts. The Geographical map was created using QGIS software with the determination of the specimen's locations. Voucher specimens were made and deposited in a SUFA herbarium.

### 2.3 Palynological studies

The current study followed Peterson et al.<sup>[22]</sup> with some modifications. Pollen grains were kept in Carnoy solution 3:1 (three parts ethanol absolute and one-part glacial acetic acid) for 24 hours, washed with sterilized water, and kept in 70% ethanol for the time of use. Aceto-Orcein was used to stain the pollen. A light microscope (LM) was used to visualize the pollen grain.

Scanning electron microscope (SEM) method was conducted to examine the exine sculpturing of pollen in detail. The pollen grains were first hydrated with 10% KOH for 10 minutes, then rinsed with distilled water and dried before mounting on a coated gold plate. The SEM micrographs were taken with a TESCAN-MIRA3. In reference to the pollen terminology explanation, the current study followed that of Halbritter et al.<sup>[23]</sup>.

## 3. Results

### 3.1 Taxonomic treatments and species description of *Iris zagrica* subsp. *penjwenica* Hoshman and Rubar (subsp. nova)

TYPE: IRAQ. Kurdistan region, Sulaimanyah district MSU district, Penjwen subdistrict, Sharbazher, Derei Saru, Gmo, subalpine rocky grassland, 1320-1410 m, 36. 444 N; 44. 755 E, 14 -20 March 2023; 35. 653 N; 45. 960 E. 24 March 2022; Hoshman Omar Majeed (Holotype: SUFA 534; Isotype: SUFA 538).

The height of the plants reaches 12-17 cm at the flowering stage. Bulb is tunicated, 2.0-2.5 cm in length, 0.8-1.7 cm in diameter, tunics fibrous, and reticulated. Two types of roots exist. The first Roots type is fibrous, creamy in color, and grows up to 0.45 cm. The second is Fleshy contractile roots which anchor the plant. Leaves 1-3, 10.0-15.0 cm length continuous in growth up to 50.0 cm, dark green, isosceles trapezium in transverse section, end up with 0.3-0.4 cm yellowish rib. Each leaf is enwrapped by two transparent sheaths. Stem not obvious, branchless terminates with a solitary flower, covered with papery stem bract, 6.0-10.0 cm length, 0.5-1.0 cm width, creamy at the lower half, dark green at the upper half, edge glabrous. Bract is 5.0-8.0 cm in length, 0.5-0.7 cm in width, green, covered ovary, apex obtuse. Bracteol length is nearly as same length as bract, green, 0.2-0.4 cm width, apex obtuse. The ovary is 1.5-1.7 cm long, 0.2-0.3 cm in diameter, light green, pushed by a pedicle to the surface of the ground. Pedicle 6.0-7.5 cm in length, 0.12-0.25 cm in diameter, light green. Flowers tube 4.0-4.7 cm in length, light green, carries one flower. Flower purple. Outer perianth segments 4.0-4.4 cm in length, 0.4-0.6 cm width from the middle, dirty yellowish-green in the middle of the abaxial, in the middle of the adaxial there is a line-colored light green, it has many purple spots, both sides of this line is colored clear white which is blotched with short purple strips toward edges from both sides and continue to

the lamina. The blade of fall is deep purple from the inner side, round in shape, acuminate apex, 1.0-1.4 cm in length, 0.9-1.1 cm width, dirty green from the backside. Standard (inner perianth segments) 3.5-4.1 cm in length, 0.4-0.6 cm broad, purple color, upright, tapering toward the centre of the flower, lanceolate. The gynoecium petaloid, style 3.7-4.0 cm in length, 0.5-0.7 cm broad, light purple, ends up with two dark purple lobes, lobes 0.9-1.0 cm in length, 0.4-0.5 cm in width. Stigma petaloid comprises two very tiny lobes, light lilac. Stamen located between outer perianth segments and styles, filament 1.0-1.2 cm in length, light purple, stained with purple spots; anther about the same length of filaments, colored light pale purple, stained with purple spots. Capsule 3.0 cm in length, 0.5-0.7 cm width. The beak is 1.0-1.5 cm long and persists with the capsule. Pollen purple-dirty white.

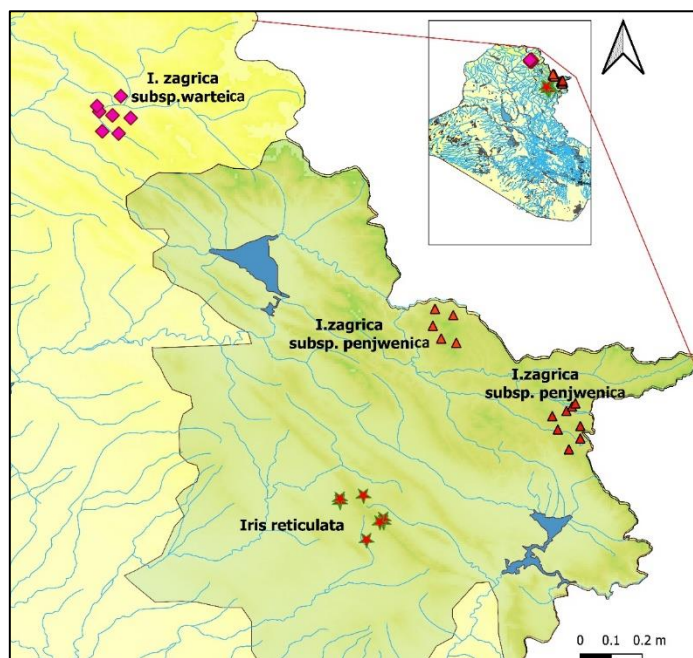
Habitat and distribution: Kurdistan region Iraq, MSU district, Penjwen, Sharbazher-Derei Sarw, South-East of Gmo mountain. It grows at the altitude of 1360-1410 m in sandy clay on the sides of the mountain, together with *Iris sp.* under and around the *Quercus* tree.

Flowering Time: March-April

Etymology: The new subspecies is named in honor of the Penjwen subdistrict, Kurdistan region Iraq, (Figures 1, 2, 4).

Vernacular name: Biznê Rishê (Bearded goats in English) and Gullê Zamaq.

Red list Assecment: A distribution area of approximately 5–10 km<sup>2</sup> was occupied by this subspecies. We collected specimens from two locality, and we counted more than 100 individuals in that location. There were grazing effects on its distribution area and the direct observation. Based on the above data, the IUCN<sup>[16]</sup> red list category of *Iris zagrica* subsp. *penjwenica* is suggested as “Vulnerable” [VU B1ab(i,ii,iii)].



**Figure 1:** Geographical distribution map of *Iris zagrica* subsp. *penjwenica* (▲), *Iris zagrica* subsp. *warteica* (◆) and *I. reticulata* (★) in Kurdistan Region Iraq.





**Figure 2:** (A) Fruit, Capsule, (B) Plant Habitus in the natural field collected from Penjwen countryside in the Iraq-Kurdistan region. (C) Flowering parts.

### 3.2 Taxonomic treatments and species description of *Iris zagrica* subsp. *warteica* Hoshman and Rubar, (subsp. nova)

**TYPE:** IRAQ. Kurdistan region, Erbil district, Ziny-Warte, Warte subdistrict, subalpine rocky grassland, 1360-1410 m, 36. 444 N; 44. 755 E. 13 March 2022, Hoshman Omar Majeed (Holotype: SUFA 535; Isotype: SUFA 539).

The plant is geophytes, 15.0-20.0 cm height. Bulbs slightly small, 1.0-1.5 cm in length, 1.0-1.5 cm width, covered with dark-moderate yellow (or pale brown colored) reticulate netted tunics. Root adventitious, creamy. Leaves 1-2, four-sided, dark green, covered with a papery leaf from the base extending up to nearly half of the real leaf resembles (bracts), the shorter 4.0-5.0 cm length, 1.0-1.5 cm width; longest leaf 10.0-12.0 cm in length, 1.2-1.4 cm width at the blooming stage. The real leaf is 15.0-22.0 cm in length at anthesis, and the length increases gradually until the end of the growing season up to 30.0 cm in length; the leaf cross section an isosceles trapezium; at the apex, each leaf ends up with a rib-like appendage colored white, 0.4-0.6 cm length. The pedicle was 10.0-20.0 cm in length, transparent, with three unequal leaves, the largest 6.5-12.0 cm in length, 1.0 cm in width, covering the stem, creamy at the base, and green at the apex. Bracteoles two, unequal, green; shortest 3.5-4 cm length, 0.5-0.6 cm broad, obtuse; longest 10cm length, 1.0-1.2 cm broad, green, obtuse. The ovary is above 1.8-2.0 cm in length, pale green, carried by a pedicle, 3.0-3.3 cm in length, and comes to the above ground by 8.0-10 cm. Perianth tube 2.2-2.5 cm in length, pale green, ended by a scorpion-like, solitary flower. The flower perianth violet-purple consists of three outer segments (Fall), 3.8-

4.1 cm in length, and 0.8-0.9 cm broad in the middle. Blade of the fall deep purple, 0.8-1.0 cm length, 0.9-1.1 cm broad. Crests are obvious, yellow, and stained with black spots. Lamina yellow, stained with black spots or short lines from both sides, purple lines along the outer perianth from the inner side to the claw, from the outer side, pale creamy or dusty, mixed with yellow-greenish inner sidelines can be seen. The second leaf (standard), is upright, 3.5-4.0 cm in length, 0.3-0.4 cm broad, violet in the middle, and pale toward both side edges. Third leaf (petaloid stigma) 0.8-1.0 cm broad, 3.5-3.7 cm length. Segments are divided into two lobes at the end, 0.7-0.8 cm in length, 0.4-0.6 cm broad, pale violet. Anther 1.3-1.5 cm length, deep violet before opening, white or yellow when it opens, spreading pollen from the opposite side to the fall leaf. Pollen yellow to white. Filament petaloid, spotted with short purple lines, 1.0-1.5 cm in length, 0.2-0.3 cm broad.

**Habitat and distribution:** Kurdistan region Iraq, Erbil governorate, Warte subdistrict. It grows at the altitude of 1360-1410 m in sandy clay on the sides of the mountain, together with *Iris aucheri* under and around the *Quercus* tree (Figures 1, 3, 5).

**Flowering time:** March-April.

**Etymology:** The new subspecies is named based on honor of the Warte subdistrict, Ruwandiz district, Erbil, Kurdistan region Iraq.

**Vernacular name:** Gullê Newrozê, Pelezê, Belezîzk, Bilbilaze, Gulbiza, Gulhirç, Gulhirçok

**Red list Assessment:** A distribution area of approximately 5–10 km<sup>2</sup> was occupied by this subspecies. We collected specimens from a single locality, and we counted fewer than 100 individuals in that location. There were grazing effects on its distribution area. Based on the above data, the IUCN<sup>[16]</sup> red list category of *Iris zagrica* subsp. *warteica* is suggested as “Vulnerable” [VU B1ab(i,ii,iii)].



**Figure 3:** (A) Plant Habitus in the natural field collected from Ziny-Warte, Warte subdistrict in the Iraq-Kurdistan region, the yellow arrow shows the above-ground ovary covered with green. (B) Close-up of the plant habitus. (C) Flowering parts.



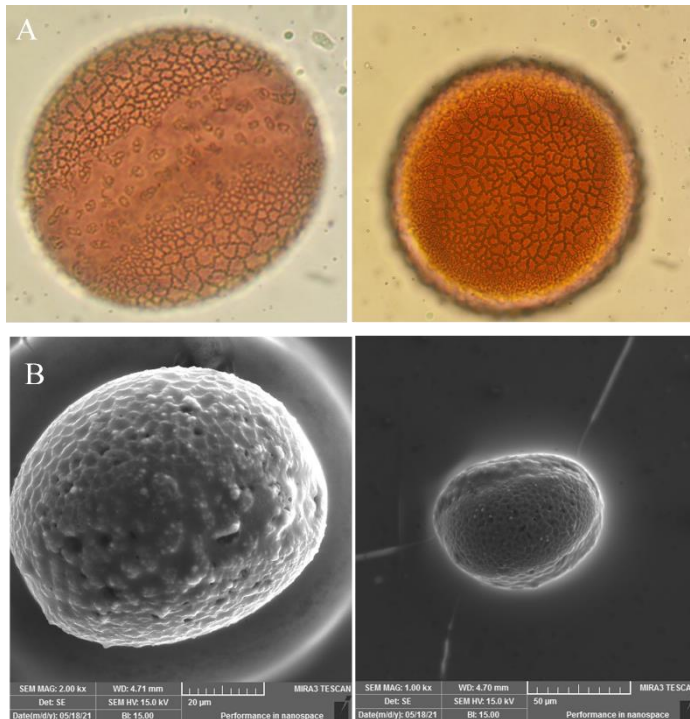
### 3.3 Palynological Study

For the first time, we conducted the palynological inference for both subspecies, although they are not that informative, especially at the level of subspecies. Perhaps this will apply to the higher rank. The pollen grain of both plant's dispersal monad and aperture types is sulcate.

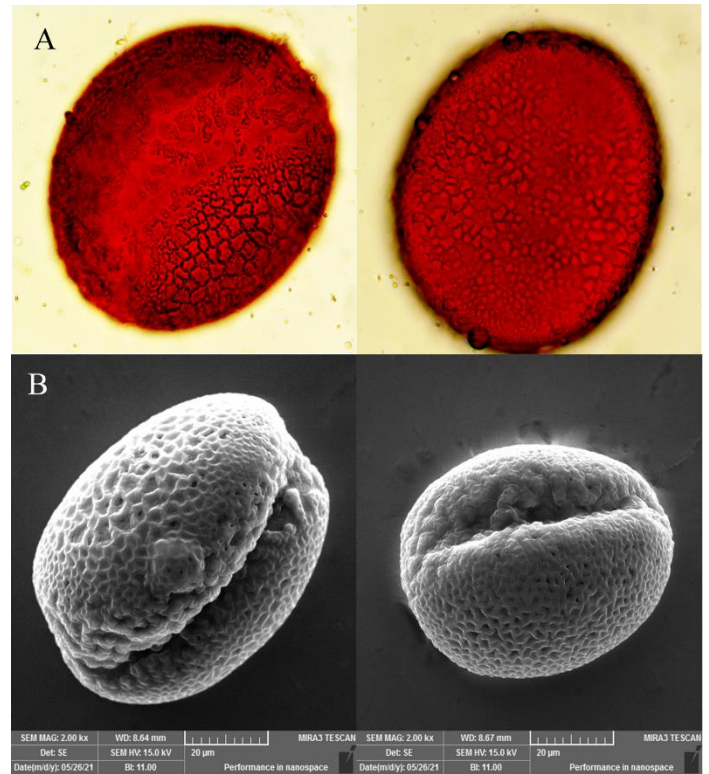
In General, the pollen of both subspecies is sandwich shape, exine pattern reticulate type, and monosulcate. The differences in the size and shape of the pollen between the two subspecies are obvious, the subsp. *penjwenica* possess larger pollen ( $73.33 \times 57.5 \mu\text{m}$ ) than subsp. *warteica* ( $67.69 \times 65.38 \mu\text{m}$ ), this trite leads to a change in the pollen shape, as the subsp. *warteica* pollen is more spherical than the elongated pollen shape of subsp. *penjwenica* (Table 1). The SEM microscope showed that the pollen wall is semitectate columellate (Figure 4, 5).

**Table 1:** Comparison between the two sub-species pollen grains.

| #  | Pollen traits                   | <i>Iris zagrica</i> subsp. <i>penjwenica</i>    | <i>Iris zagrica</i> subsp. <i>warteica</i> |
|----|---------------------------------|-------------------------------------------------|--------------------------------------------|
| 1. | Pollen length ( $\mu\text{m}$ ) | 73.33                                           | 67.69                                      |
| 2. | Pollen width ( $\mu\text{m}$ )  | 57.5                                            | 65.38                                      |
| 3. | Pollen Shape                    | Sandwich shape, Spherical, and reticulate cover | Sandwich shape and reticulate cover        |



**Figure 4:** Pollen morphology of *Iris zagrica* subsp. *warteica*. A; the Light microscope images. B; the Scanning electron microscope image.



**Figure 5:** Pollen morphology of *Iris zagrica* subsp. *penjwenica*. A; the Light Microscope images. B; the Scanning Electron Microscope image.

### 4. Discussion

The current study found two new subspecies in the Kurdistan region of Iraq for the first time (*I. zagrica* subsp. *penjwenica* and *I. zagrica* subsp. *warteica*). These plants were previously applied to section *zagrica* from subgenus *hermodactyloides* in Iraq by Majeed [14], who depended on molecular and morphometric analyses. Here, we described them in detail and recorded them for the first time to the flora of Iraq. Mathew and Zarrei [18] described *Iris zagrica* subsp. *zagrica* in Iran and Moet et al. [20] described some species in this section as new species. However, there was no molecular study done for them to compare with Majeed [15] plants, and morphologically, they differ from our new findings. So, we gave these plants the rank of subsp. as they are geographically far from each other (Figure 1 and Table 2).

**Table 2:** Comparison of morphological characters of *I. reticulata*, *I. marivanica*, *I. zagrica* subsp. *warteica* and *I. zagrica* subsp. *penjwenica*.

| #  | Characteristics                    | <i>I. reticulata</i>                                           | <i>I. zagrica</i> subsp. <i>warteica</i> | <i>I. zagrica</i> subsp. <i>penjwenica</i> | <i>I. marivanica</i>                                                       |
|----|------------------------------------|----------------------------------------------------------------|------------------------------------------|--------------------------------------------|----------------------------------------------------------------------------|
| 1  | Plant height (cm)                  | 7–15                                                           | 15–20                                    | 12–17                                      | 14–16                                                                      |
| 2  | Leaf shape                         | four-sided (Square) leaf in the transverse section             | isosceles trapezium                      | isosceles trapezium                        | quadrangular in cross-section                                              |
| 3  | Perianth tube length (cm)          | 4–7                                                            | 2.2–2.5                                  | 4.4–4.7                                    | very short                                                                 |
| 4  | Outer perianth Segments            | blue, violet or purple blue violet, pale blue and whitish blue | Whitish blue to Purple violet            | Purple                                     | deep lilac purple becoming darker at the midrib, with blackish purple haft |
| 5  | Inner perianth Segments (Standard) | blue, violet                                                   | Purple, whitish blue                     | Purple                                     | Same as the outside color                                                  |
| 6  | Spathe bract length (cm)           | 5.0–7.0                                                        | 6.5–12                                   | 6–10                                       | Not given                                                                  |
| 7  | Capsule length (mm)                | 30–35                                                          | 35–57                                    | 15–55                                      | 50                                                                         |
| 8  | Beak length (cm)                   | beak-less (remained perianth tube)                             | 1.8–5                                    | 1.9–4.5                                    | 2.5–3.0                                                                    |
| 9  | ovary position (Pedicel length)    | underground or just above ground                               | above ground or just aboveground         | above ground or just aboveground           | above ground or just aboveground                                           |
| 10 | Elevation (m)                      | 600–2700                                                       | 1360–1410                                | 1380                                       | 2130                                                                       |
| 11 | Distribution                       | N of Iraq, Iran, Transcaucasia Qopi Qaradagh                   | Ziny-Warte, Korek Mountain               | Penjwen                                    | pass between Marivan and Saqqez                                            |
| 12 | Flowering time                     | February–March                                                 | March–April                              | March–April                                | soon after snowmelt, ~April                                                |

Regarding accessions collected from the Penjwen subdistrict, the study found color variations within the same populations, such as deep purple, pale purple, and even whitish blue. These plants are very resembled both *Iris marivanica* and *Iris avromanica* of Moat et al. [21]. Such a case means that ranking these plants as species from one population is not accurate as subspecies, as the biological species concepts clearly explain that two different species cannot interbreed [24]. Concerning the plant from the Warte subdistrict, morphologically, it resembles *Iris zetterlundi* (Figure 90 in Moat et al. [21]), but we could not find any DNA data for confirmation molecularly with our plant from Warte, and some taxonomical features are different such as ovary position, and leaf transverse section.

## Conclusion

Two new subspecies applied for the first time to the flora of Iraq from the Kurdistan region. *Iris zagrica* subsp. *penjwenica* and *Iris zagrica* subsp. *warteica*. These plants are morphologically described and considered that the most distinctive characters are leaves transverse sections and ovary position, which are isosceles trapezium and aboveground ovary, respectively. Further comprehensive studies should be conducted in several scopes, such as chromosome number, breeding, and chemotaxonomy.

## Conflict of interests

There is no conflict of interest

## Author Contribution

Both authors collected and analyzed data and wrote the paper.

## Acknowledgment

We are highly grateful to thank the University of Sulaimani, the College of Agricultural Engineering Science, and the departments of Horticulture and Biotechnology for their technical support.

## Funding

The authors received no financial funding.

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