Cheilanthes tomentosa Link (Pteridaceae) new addition to the recorded Pteridaceae species in Iraq.

Maulood B.K.1, Ismail A.M.2, AL- Amery, M.M.2, and AL-Khasreji, T.O.3

1Presidency of Kurdistan regional government scientific council. Erbil, Iraq
2University of Baghdad-College of Science for Women. Iraq
3University of Tikrit-College of Education for pure Science. Iraq
E-mail: n.office@su.edu.krd

Abstract. During a survey of Iraqi flora 2010 onward, which is undertaken by Howler Botanical Garden, an interesting fern is recorded. The taxon is identified as Cheilanthes tomentosa Link., based on morphology and anatomy characters. To the best of our knowledge, C. tomentosa has not previously been reported in Iraq. Therefore, the species represent a new addition to the Iraqi flora.

Keywords: Ferns, Pteridaceae, Cheilanthes. New record Iraq

1. Introduction
In contrast to seed plant flora, apart from algae only a few scientific papers could be found about lower vascular plants (Cryptogams) in Iraq [1,2,3,4,5,], however (6 and 7) had recently published two reports depending on previously known information about ferns in Iraq. The present investigation is an attempt to focus on a single species of wooly lip fern (Cheilanthes tomentosa Link.) which is found and recorded for the first time in the country. It's known that Cheilanthes as a genus of ferns is quite diverse in its habitat with about 150 known species that have a worldwide distribution [8] in contrast. So far only two species of this genus have been recorded in Iraq [9,10]. Both species of the genus were classified under the Adiantaceae family [10].

Modern fern taxonomist includes Cheilanthoid fern into the family Pteridaceae which have been divided into five subfamilies that include Cheilanthioideae [11, 12] their classification had based on recent molecular studies in addition to morphological data. Habitat wise some species of Cheilanthes were found to be restricted to sedimentary rocks such as limestone or calcareous sandstone while others occur more frequently on igneous rocks such as basalt or granite, still, the same other species are known to be xeric-adapted ferns [13, 14, 15]. In contrast, the recently recorded species of C. tomentosa in Iraq were found to grow on calcareous sandstone soil & warm climate only [3].

The present investigation is an attempt to highlight on ecology and morphology of C. tomentosa, which is recorded for the first time in Iraq the study will deal with a detailed description of the morphology and ecology of the species in Iraqi Kurdistan as its recorded for the first time and will raise the known number of Cheilanthes species to five in Iraq as follows: C. pteridioides, subsp. acrostica, C. persica, C. fragrans, C. margirata and C.tomentosa.

2. Materials and methods
The mature sporophyte of the fern was collected from Bawanoor region Ahmoookair village about 30 Km Northeast of Kalar city within the Garman district of Kurdistan of Iraq. The plant has been recorded in the field within a studied site which was located at about 313 m (a.s.l) and GPS reading was (34º 50.026 N, 045º 31.119 E). Soil samples were collected from the studied area and kept in plastic bags for detail ecological parameters determination (pH, EC, cations, anions, nutrients, TOC and soil texture) following the standard method [16]. The fresh plant samples were brought back to the laboratory in the Hawler Botanical Garden in Erbil Governorate and divided into two groups after identification: the first group was used for the morphological study by using dissecting and compound microscope whereas the second part was kept and preserved in a fixative solution F.A.A [17]. Enough voucher specimen was
deposited in the Hawler Botanical Garden/ (H.B.G) Kurdistan under the number (4,19,2 Ch. to.) in Erbil Governorate, Kurdistan of Iraq.

The scientific classification was followed according to [11].

- Division: Pteridophyta
- Class: Polypodiopsida
- Order: Polypodiales
- Family: Pteridaceae
- Subfamily: Cheilanthyioideae
- Genus: Cheilanthes Sw.
- Species: C. tomentosa Link. (woolly lip fern)

3. Result and discussion

In general ferns distribution in Iraq is known to be restricted to a specific area for example Salvinia and Marsilia are found in southern marshes only, whereas most others are in general restricted to the mountainous Kurdistan part. However, still, there are others, such as Adiantum and Equisetum that are more widely distributed their habitat may extend from north to even the middle part of Iraq [3, 7].

Cheilanthes as a genus which is the concern of the present study so far has been known and recorded in only one site in the northeastern part of Iraq, with its two species C. fragrans (L.) Webb (C. pteridioides subsp. acrostica) and C. persica L. (Borry) [10]. In fact, it seems that Cheilanthes is one of the quite rare ferns in Iraq as it found and confined to calcareous sandstone habitat within dry cliffs at the warm climate in Kurdistan, however in addition to the two known species of Cheilanthes. Another species C. tomentosa Link. (wooly lip fern) has been recently identified in the Garmian district of Kurdistan of Iraq, which is regarded as a new record for Iraqi flora there for it will raise the species number of Chielanthes in Iraq to five.

Habitat wise the newly recorded species was found to be generally associated with another fern C. pteridioides, in fact, Cheilanthyoid ferns are known to prefer growing on the alkaline soil texture, as it was referred to by [15]. This species was also recorded in Diyarbakir, Turkey [15] who explained its ecology in detail. Whereas [17] have also studied this species in Georgia and found that it grows on granite and the sandy rock substrate even on the elevation of about 600 m above sea level.

The ecological characters of the newly recorded species are summarized in table (1). Whereas the annual mean of metrological data for the studied area was taken from the nearest metrological station that was of Suliamaniyah and it was as follows.: Temperature (40.3 C) humidity (52%) and rainfall (98 mm).

| PH | EC µs/cm | CO₃ Ppm | K Ppm | Na Ppm | Ca Ppm | Mg Ppm | PO₄ Ppm | NO₃ Ppm | SiO₃ Ppm |
|----|----------|--------|------|--------|-------|-------|--------|--------|--------|
| 0.8| 799      | 235    | 12.3 | 35     | 38    | 14    | 0.02   | 0.01   | 130    |

Table 1. Ecological characters and soil properties of the studied site.
Figure 1. Morphological & anatomical characters of *C. tomentosa.* (a) *C. tomentosa* (whole plant) in the lab. (b) pinna adaxial. (c) *C. tomentosa* in the natural habitat (d) c.s of sorus with sporangium. (e) mature sporangium

4. Morphological study

*Cheilanthes tomentosa* Link., found to be a herbaceous fern generally 8-14 cm long. Fronds are up to 10 cm. its bright green in color. Petioles are very short, not more than 1cm long brown color with hairs and around 1.5 cm wide, the pinna is divided into five pinnules, a rhizome is a conical shape and 1cm long whereas, roots are 1 - 2 cm long, pinna abaxial with a very dense layer of hairs (Figure 1a-c). The spore sac makes a cluster structure on the lower surface of the pinnae that also covered with a dense layer of hairs. The lower epidermis of the pinnae are holding the reproductive structure. The mature sporangium is stalked globular in shape with thick annuals cells and covered with hairs (Fig.1d-e). The spores are smooth, pyramid in shape or triangles. In fact, all these features come in accordance with the description given by [18, 19, 20]. Furthermore, whenever contrasting chemo taxonomical analysis of the various species of *Cheilanthes* it becomes evident that flavonoid content of *C. tomentosa* is much
more and higher than that of *C. pteridioiodes* as the value in first was more than double of that of the newly recorded (666 mg/ml) in contrast to (325 mg/ml), in *C. pteridioiodes*, as a matter of fact, it is known that flavonoid content of the plant has a big role in protecting plants from environmental stress and flavonoids can be influenced by environmental changes [21, 22]. So phenols and other bioactive compounds act as a chemical interface between plants and the environment [23], mainly the flavonoid compounds can be influenced by environmental and geographical variations [24]. The detailed morphological and ecological descriptions of *C.tomentosa* and its presence in the Kurdistan part of Iraq and even the whole of Iraq have been forwarded in the present paper for the first time there for it had raised up the number of known species of *Cheilanthes* to five.

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