



Research article

Morphological, anatomical and geographical distribution studies of species *Strigosella africana* (L.) Botsch. in Iraq

Lamia A. Gharb^{1*}

ABSTRACT

Strigosella africana is wide distribution in Middle East. The morphological, anatomical features and geographical distribution of this plant in Iraq is scanty in literature. Thus, in present study, these were covered. The plants were collected from different districts of Iraq. The anatomical, morphological and geographical studies were conducted in present study. Our study provides first time the anatomical study about the stem, root and leaf of *S. africana*. Moreover, uniform kind of hairs was described. Three kinds of hairs were found on stem, simple unicellular with thick wall, unicellular hair with a bulge near the base and forked with either two or three branches. While, in leaves three kinds of hair were also found, simple unicellular hairs, forked with either two or three branches and two armed calcified hair, the last one has been described first time in present study. The morphological features of this plant were similar to general morphological characters of its family Brassicaceae (Cruciferae). The characters and numbers of nectar glands in *S. africana* were described first time here. It has pentagonal shape and located in the base of the stamens. Moreover, the number of these glands was six. The distribution of *S. africana* was all over the studied area (Iraq). Our study proved that the plant can grow on different kinds of soil that gave priority for this plant to appear in different geographic area. The present study gave the original information about the anatomical characters of *S. africana* and the uniform of hairs and nectar glands. These features may help in classification of this plant. Furthermore, the study shows the *S. africana* is widely distribution allover the Iraqi districts. The data of this study may help in updating the characters of plant presented in flora of Iraq.

Keywords: *Strigosella africana*, Iraq, Morphology, Anatomy, geographical distribution.

Citation: Gharb LA. (2014) Morphological, anatomical and geographical distribution studies of species *strigosella africana* (L.) Botsch. in Iraq. *World J Exp Biosci* 2: 6-12.

Received April 10, 2014; Accepted May 6, 2014; Published May 10, 2014.



*Correspondence: azgair2000@gmail.com
Department of Biology, College of Science, University of Baghdad, Baghdad, Iraq
Full list of author information is available at the end of the article

Copyright: © 2014 Gharb LA. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any site, provided the original author and source are credited.

INTRODUCTION

The vascular plant family Brassicaceae (cruciferae) or mustard family is a monophyletic group of about 338 genera and 3709 species distributed world wide. It includes many economically important ornamental and crop species (vegetables or sources of industrial and cooking oils and forage) [1]. This family has many members that stimulate the immune system through cells that play a certain role in host defense [2-4]. Most members of this family can be easily identified by morphological characters such as cruciform corolla. This family composed of three species in Iraq [5]. The genus *Strigosella* (L.) Botsch is a member of the family Brassicaceae (cruciferae). *Strigosella* is derived from the Latin word (*Strigosus*) which mean having prickly hairs [6]. The species *S. africana* previously was classified as *Malcolmia africana* [7-11] but Unal and Ozgokce (2008) was referred that the genus *Strigosella* considered a synonym of *Malcolmia* [12]. Finally Kaya et al. (2011) found that *M. africana* was belonging to the genus *Strigosella* of the tribe Euclidieae [13]. The phylogenetic relationships between *Malcolmia* and *Strigosella* referred that *Strigosella* phylogenetically different from *Malcolmia* species [14].

Currently the morphological revisions of various plant taxa are often supported by molecular data [15]. The taxonomic data that collected from the diversity of plant DNA is a powerful tool in resolving the taxonomical and systematical problem [14]. However, the molecular methods have a number of disadvantages such as the sensitivity of these methods, as these methods should be utilized with special care. According to these reasons, the morphological classification can not be rule out.

First record of *S. africana* in different locations had been reported by many investigators. The reported that this distributed in different places such as, Iran, Syria, Palestine, Sinai and Egypt, Greece, Turkey, as well as in other countries of the Mediterranean, Crimea and eastwards to Mongolia, China and India [10,16-18]. Akhani (2003) found this species had been recorded as a one of very important flora in Iran for more than 30 years [18]. However, the geographic distribution of this species in Iraq is scanty.

That is why; we tried to cover the morphological and anatomical characters of the vegetable organs of this species. Moreover, the geographical distribution of this species was also studied here.

MATERIALS AND METHODS

Sample collection

S. africana was collected from the gardens of Baghdad University as well as from the dried

specimens that preserved in the University Herbarium (BUH), Baghdad, and the National herbarium of Iraq, ministry of Agriculture (BAG), Baghdad, Iraq.

Measurement and morphological observations

All morphological data for different parts of species *S. africana* was conducted manually. Free hand sections of vegetative organs (leaf, stem and root) were used to prepare anatomical sections. To get the fine section preparations, the standard method of Paraffin wax was followed [19]. Different sections from each plant sample were analyzed under dissecting microscope (Accu-scope 3013 Phase Trinocular Halogen with 3.2 MP CMOS Digital Microscope Camera, New York Microscope Co.).

Plant distribution

The data of geographical distribution of plant was collected from University Herbarium (BUH) Baghdad, and from the National herbarium of Iraq, ministry of agriculture (BAG), Baghdad, Iraq. The studied area (Iraq) was divided into different districts according to previous study [20].

RESULTS

Morphological study

Fig. 1a shows that the tap root has few secondary branches with yellowish brown color. The stem branches started from the base of stem with little branches appeared above. The green and dark violet color was seen on the base of stem. We found that the surface of the stem covered with glandular hairs.

The leaves of this plant are covered with hairs (**Fig. 1b**). This species has 4-5 simple basal leaves. The leaf has elliptic shape with margin serrate in lower part of leaves and it was entire in above part. Moreover, it has acute apex and cuneate base. However, Lower cauline leaves were oblanceolate shape. Both leaves were petiolate but the upper cauline leaves had very short petiole or sessile with elliptic shape. The margin of last kind of leaves have 3 middle dents and they were entire from upper and lower regions (**Fig. 1c** and **d**). The inflorescence is simple raceme with pink to violet flowers which have lanceolate sepals with whitish margins and furnished with dense hairs. Sepals have acute apexes and truncate bases. The sepals arranged into two cycles, the outer is narrower and deeply cucullate at the tip, while the inner has different shape (**Fig. 1e**). Figure 1(f and g) showed that petals have glabrous and oblanceolate shape. The limb was pale pink before dehiscence and then became violet color after dehiscence, while the claw was green to whitish color.

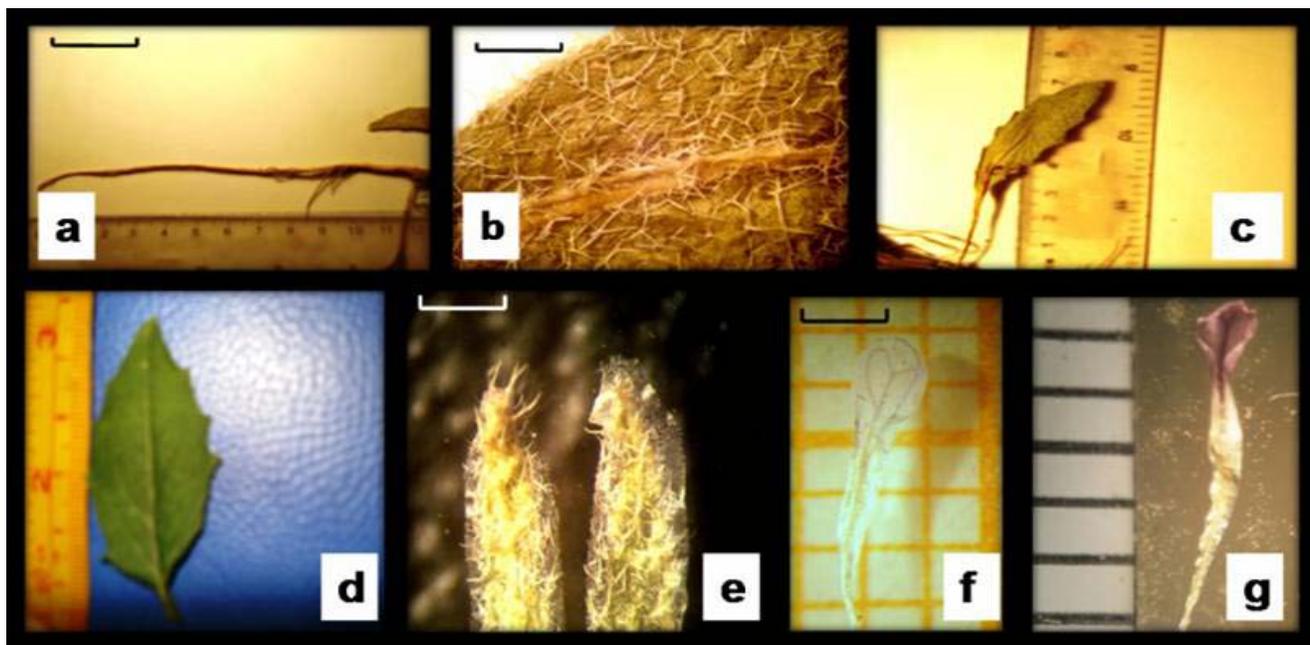


Fig. 1 Morphological characters of *S. africana*. a: Root, b: Hairs on the leaf surface (bar, 0.7 mm), c: Lower cauline leaf, d: Upper cauline leaf, e: Sepals (bar, 0.96 mm), f: Petal before dehiscence (bar, 0.75 mm), g: Petal after flower dehiscence (bar, 0.7 mm).

Gynoecium with hairy green ovary which was cylindrical to oblong in shape without style and the stigma was acute (fig. 2a). Androecium was hexandria (tetradynamous), filament of the stamen was pale yellowish and the anther was oblong sagitate with pale green (fig. 2b). The character and number of nectar glands in studied plant were described first time here. It has pentagonal shape and located in the base of the stamens, moreover the

number of this gland is 6 (fig. 2c). Fruit was narrowly linear siliqua in straight shape, It was green and become pale brownish in maturity with many hairs (fig. 2d and e). The seed was oblong with yellow to pale brown; the embryo was folded with black curved line in the attachment point of the two cotyledons and the seed with narrow invagination (fig. 2f). The measurement of different species parts were shown in table 1.

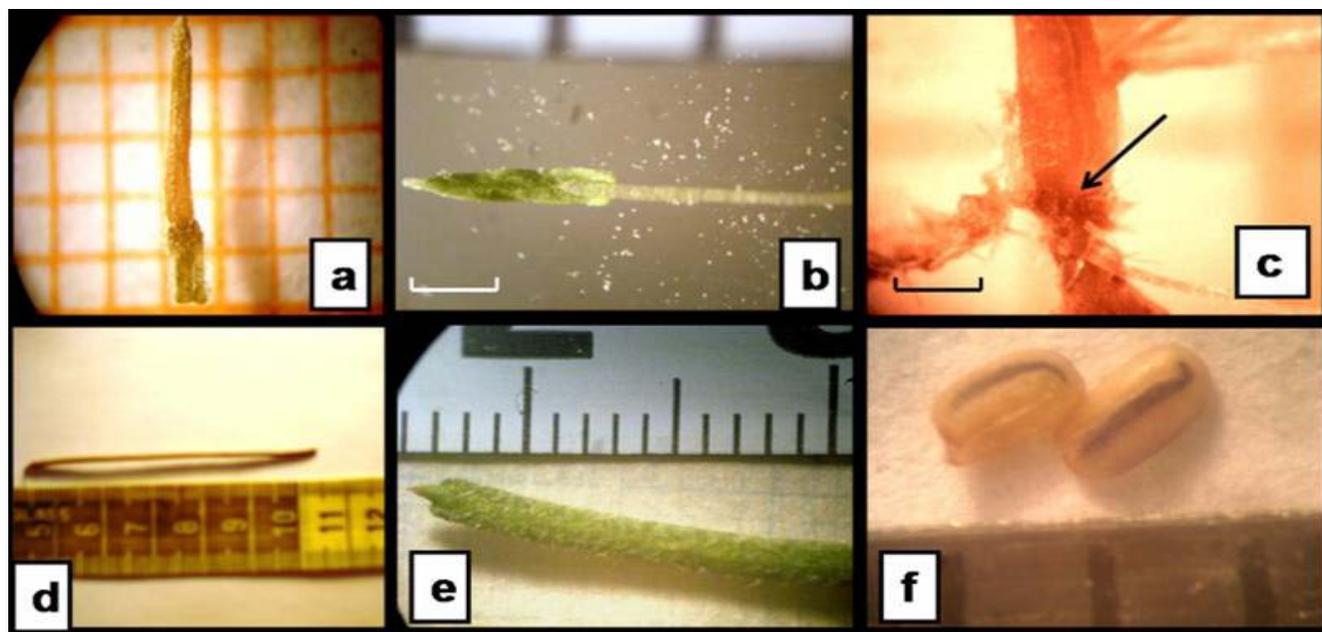


Fig. 2 Morphological features of floral parts of *S. africana*. a: Pistil (bar, 0.9 mm), b: Stamen (bar, 0.8 mm), c: Nectar gland (bar, 0.8 mm), d: Mature fruit, e: immature fruit, f: Seeds (bar, 0.7 mm).

Table 1. The dimensions of the vegetative and floral parts of *S. africana*

Plant part (n, 50)	Length (mm).	Width (mm).
Root	25- 120	2- 7
Stem	150-180	3- 7
The basal leaves The petiole	50-70, 15-25	15-20, 2-3
The lower cauline leaves The petiole	40-55 20	10-30 2
The upper cauline leaves	20- 40	9-10
Sepal	3.5 – 4	0.7-1
Petal	4.5 -7	1
Filament	2- 2.5	0.1
Anther	1- 1.5	0.2-0.3
Ovary	4 - 4.5	0.8-1
Fruit	30-50	1-2.5
Seed	1	0.7- 0.8

n, number of sample

Anatomical study

The dimension of the studied parts was listed in **table 2**. The current study showed that the stem was covered with cuticle and the epidermis with one or two rows of cells which have circular or globoid shape. The cortex consisted of 2-3 rows from chlorenchyma tissue which was beneath the epidermis and followed by 5-6 rows of parenchyma tissue.

The vascular cylinder composed of the phloem tissue and the xylem tissue were appeared like undulating cycle.

Table 2. The dimensions of the histological sections of the vegetative parts

Stem Width (µm)		Root Width (µm)		Leaf Width (µm)	
Cuticle	7.5-10	Cork	25-37.5	Cuticle	2.5-3.75
Epidermis	17.5-327.5	Cortex	1125	Upper epidermis	12.5-32.5
Cortex	570-650	Phloem	250	Lower epidermis	10-25
Chlorenchyma	100-125	Xylem	2125	Columnar layer	125-500
Parenchyma	550			Spongy layer	100-275
Phloem	100-125			Midrib	1750-3250
Xylem	1000-1056			Vascular bundle	500-625

While, the vascular cambium consist of two or three impacted rows of cells. The hairs of stem were divided into; simple unicellular with thick wall, unicellular hair with a bulge near the base and forked hairs with two or three branches. The root consisted of cork tissue followed by the cortex and diffuses porous wood (**Fig. 3**).

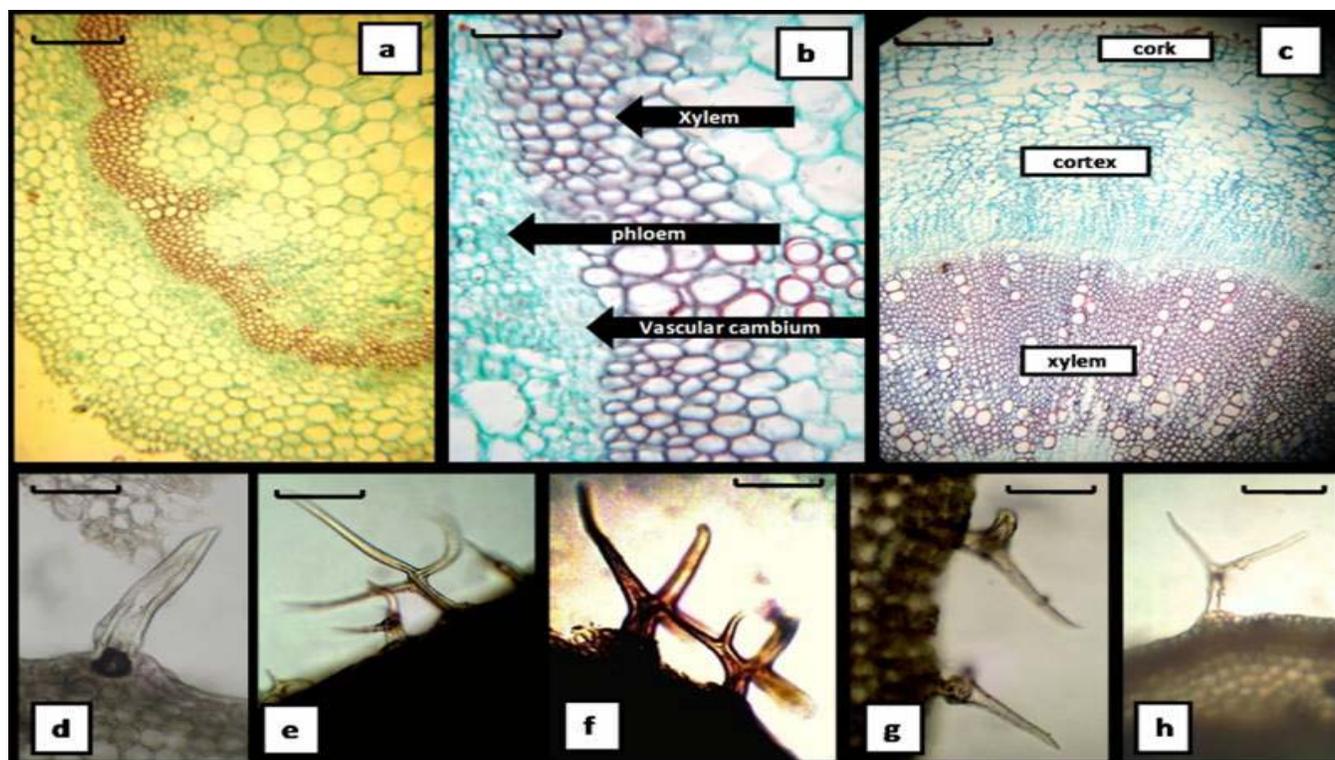


Fig. 3. Anatomical characters of stem, root and stem hairs of *S. africana*. a and b, cross sections in stem (vascular tissue), and c, cross section [bars, 200 µm, 55 µm and 190 µm in (a), (b) and (c), respectively]; d, simple unicellular hair (bar, 200 µm); e and f, hairs with three branches (bars, 200 µm); g, unicellular hair with bulge near the base (bar, 200 µm); h, forked hair (bar, 200 µm).

The leaf of this plant was characterized by a thick upper epidermis and a thin lower epidermis. The leaf consists of 2-3 rows of columnar parenchyma followed by the spongy parenchyma (Fig. 4 b). The midrib had a circular or an ovoid shape. The vascular bundle in midrib was surrounded from top up to bottom with angular collenchyma tissue (Fig. 4 a). Three kinds of

hairs on leaves were described in present study; Simple unicellular hairs (Fig. 4 c and d), Forked with either two or three branches (Fig. 4 e, f and g) and two armed calcified hair (Fig. 4 h), the last one has been described first time in present study as this kind did not described previously.

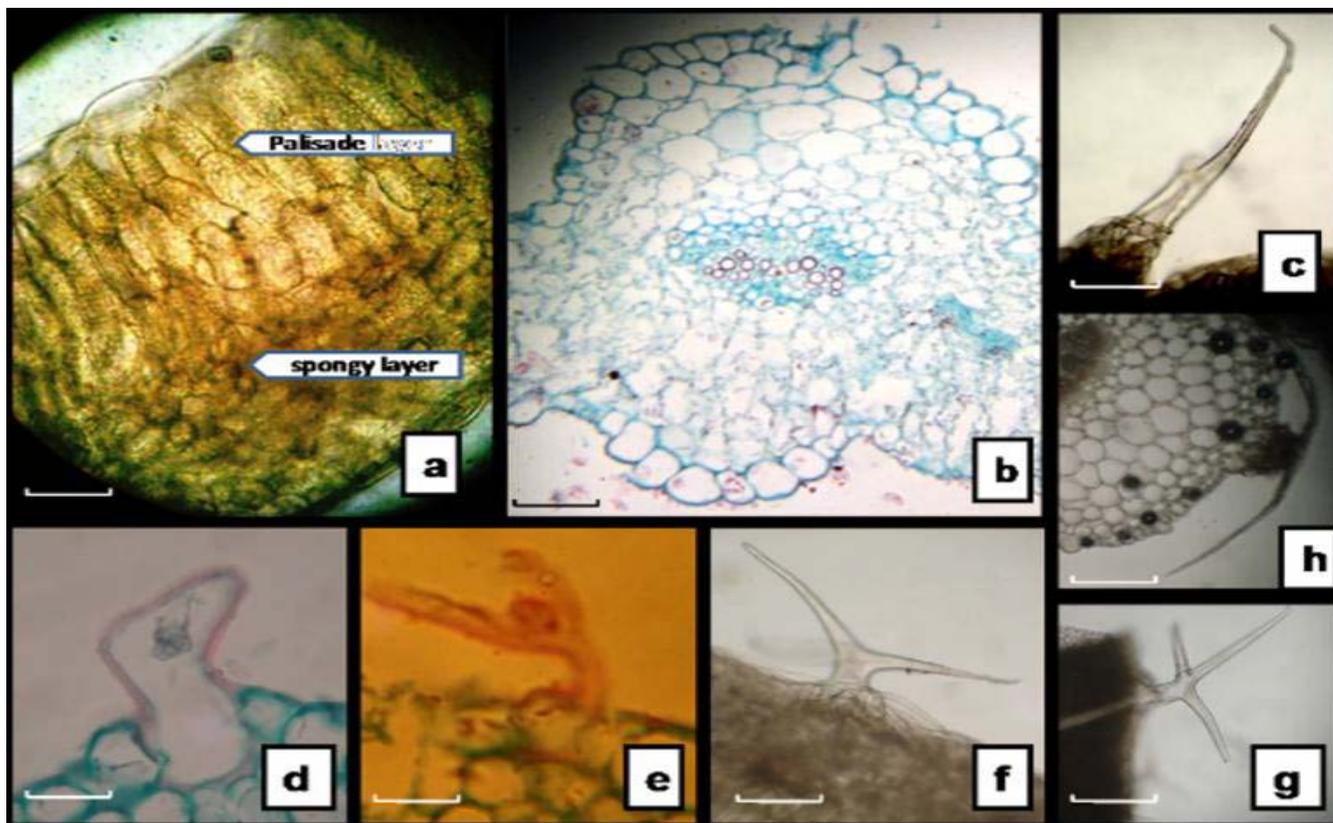


Fig. 4. Cross section in *S. africana* leaf shows palisade and spongy layers (a) (bar, 200 μ m), and leaf midrib (b, c and d, simple unicellular hair; e, f and g, forked hair with two or three branches. h, two arms calcified hair). [bars, 70 μ m, 40 μ m, 40 μ m, 40 μ m, 200 μ m, 200 μ m and 200 μ m in (b), (c), (d), (e), (f), (g) and (h), respectively]

The environmental and the geographical distribution In present study, it was observed that the *S. africana* distributed in many regions of Iraqi districts (Table 3 and Fig. 5). The results showed that the species was distributed widely in studied area. The maximum distribution was in western desert district (DWD) (16 specimens) followed by Upper jazira (FUJ), while the minimum distribution observed in Kirkuk district (FKI), Nineveh district (FNI) and Ghurfa–Adhaim district (DGA) as one sample was recognized in last three districts.

Discussion

The morphological characters of the species referred to different kinds of trichomes on leaves, stems and sepals of the flowers. The structure and dimensions of hairs are considered as the most important anatomical features for the identification of leaves of different genera and species [21]. The nectar gland provides

the character of some technical importance in the Cruciferae [5]. Fahn (1974) reported that the distribution of this gland is important in classification of this family [22]. In addition, many investigators reported that the characters of fruit and seeds have the valuable facilities for the classification of *S. africana* and its family [13, 23-25].

In our study, the morphological characters used in classification of this species as the moderate method like genetic technique not available in our laboratory, moreover the genetic method some time associated with technique and sensitivity defects. In line with this, kaya et al. (2011) used morphological characters in classification of this species [13]. In line with this, Khalik (2005) used similar morphological properties in classification of this species proving the value of morphological features in the taxonomy of members of Brassicaceae (cruciferae) [21].

Table 3. The distribution of *S. africana* in different Iraqi districts and regions

Districts	Regions					
Upper jazira (FUJ) (n: 9)	Shargat	Makhul mountain	Hadhr	Mosul campus	Hamam Alil	Hatra
Nineveh district (FNI) (n: 1)	Nineveh					
Kirkuk district (FKI) (n: 1)	Kirkuk					
Persian foothills district (FPF) (n: 2)	Saadiya					
lower Jazira district (DLJ) (n: 8)	450km.from Baghdad near Baji	Al-Tharthar	12 km west of Rawa	40 km between Rummana to Rawa	North of Rawa to Shaabani	
Ghurfa-Adhaim district (DGA) (n: 1)	20 km between Samira and Tikrit					
Western desert district (DWD)(n: 16)	Hadiha 80 km from Nukhaib	60 km north west of Ramadi	Hauran Valley	Habbaniya lake	Al-Qaser valley near Ana	17 km west of Rutba
Southern desert district (DSD) (n: 2)	Zubair	20 km. from Busaiya to Samah				
Eastern Alluvial plain district (LEA) (n: 2)	5 km. west of Tib	5 km.to Fakka				
Central Alluvial plain district (LCA) (n: 10)	Baghdad,Rustam	Abu-ghraib	Suwaira	Abu Hayat	Gharraf	
Southern Marsh district (LSM) (n: 4)	In roads between Qalat Salih and Qurna	70 km from Amara To Basrah	70 km. east of Amara near Rashaida well	Amara sugar factory		

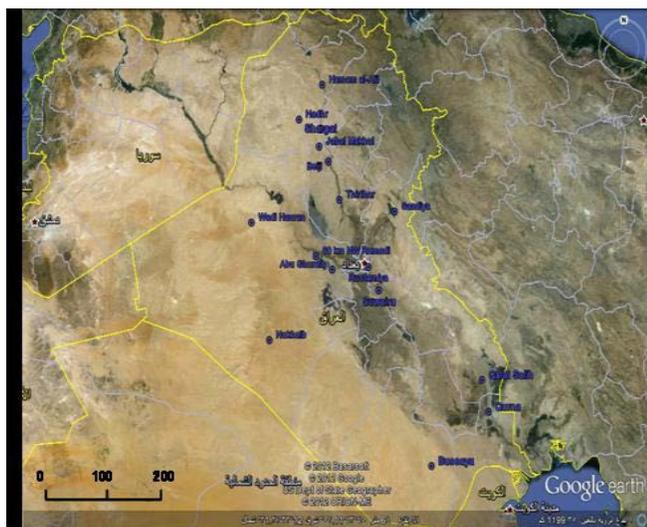


Fig. 5. Geographical distribution of *S. africana* in Iraq. This figure confirmed the wide distribution of this species all over the studied area (bar, 200 km).

To complete the study, the anatomical characters were inserted here and occupied the important area in the present study as the anatomical studies for this plant are scanty in literature. The anatomical study

highlighted on many characters which helped in morphological classification of this species. Get together, the study showed many classification characters which helped plant to distribute in extreme environments such as hairs which appeared on most of the plant surface especially on leaves.

The present study showed that this plant distributed in wide geographic area. The data that collected from different herbariums like the University Herbarium (BUH) and the National herbarium of Iraq, ministry of agriculture (BAG), Baghdad, Iraq showed that this plant grew on different kinds of soil e.g., rocky clay soil, sandy gravelly soil, sandy soil, rocky gypsum gravelly soil, date gardens, loamy clay soil, stony soil, gravelly soil between cracks in rocks and sandy loam soil. Moreover, the other investigators support our finding [26]. This finding explained the wide distribution of this plant in different ecological places. It can be concluded from present study that the morphological classification of *S. africana* is still valuable. The present study demonstrated first time the anatomical characters of this plant. Furthermore, we proved this plant is wide distributed in studied area (Iraq).

Conflict of interest:

The author declares that he has no conflict of interests.

REFERENCES

- [1] **Al-Shehbaz IA, Beilstein MA, Kellogg EA.** (2006) Systematics and phylogeny of the Brassicaceae (Cruciferae): an overview. *Plant Systematic and Evolution* **259**: 89-120.
- [2] **Anderson LJ, Cipollini D.** (2013) Gas exchange, growth, and defense responses of invasive *Alliaria petiolata* (Brassicaceae) and native *Geum vernum* (Rosaceae) to elevated atmospheric CO₂ and warm spring temperatures. *Am J Bot.* 100(8):1544-54.
- [3] **Hassan SA, Zgair AK.** (2013) Thermoregulation of IL-1 α production and phagocytic activity of *Escherichia coli* Lipopolysaccharide-induced mononuclear cells. *World J Exp Biosci.* **1**: 14-18.
- [4] **Salih DS, Zgair AK, AL-khyat RMH.** (2013) T-Lymphocytes Subsets in Patients with chronic hepatitis that showed autoimmune immune phenomenon. *World J Exp Biosci* **1**: 10-13.
- [5] **Hedge IC, Lamond JM.** (1980) Cruciferae. In: Townsend C. C., Guest E. (eds) *Flora of Iraq*: 1032. Ministry of Agriculture, Republic of Iraq. **4** (2).
- [6] **Moubasher AH, Helmy SM.** (1994) Dictionary of Botanical terms. The center for Scientific and applied research. University of Qatar.
- [7] **Post GE.** (1932) *Flora of Syria Palestine and Sina.* **1**. American press. Beirut. 72.
- [8] **Rechinger K. H.** (1964) *Flora of lowland Iraq.* Verlag von J. Cramer. 315.
- [9] **Cullen, J.** (1965) *Malcolmia africana.* In: Davis P. H. (eds.), *Flora of Turkey and the east Aegean Islands*: 460. Vol. 1. Edinburgh, University Press.
- [10] **Hedge J. and Rechinger K. H.** (1968) *Flora Iranica.* Akademische druck-u. Verlagsanstalt, Graz-Austria. No. 571:257-258.
- [11] **Migahid A. M.** (1978) *Flora of Saudi Arabia.* Vol. 1 Dicotyledons. Second edition. Riyadh Univ. Al- Mutawa press Co., Dammam. 84.
- [12] **Unal M., Özgökçe F.** (2008) A new record for Turkey: *Malcolmia intermedia* C. A. Mey. (Brassicaceae). *Turkey Journal of Botany* **32**:415-417.
- [13] **Kaya A., Unal M., Özgökçe F., Doğan B., Martin E.** (2011) Fruit and seed morphology of six species previously placed in *Malcolmia* (Brassicaceae) in Turkey and their taxonomic value. *Turkey Journal of Botany* **35**:1-10.
- [14] **Doğan B., Unal M., Özgökçe F., Martin E., Kaya A.** (2011) Phylogenetic relationships between *Malcolmia*, *Strigosella*, *Zuvanda*, and some closely related genera (Brassicaceae) from Turkey revealed by inter-simple sequence repeat amplification. *Turkey Journal of Botany* **35**:17-23.
- [15] **APG (Angiosperm Phylogeny Group).** (2003) An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG II. *Botanical Journal of the Linnean Society* **141**: 399-436.
- [16] **Townsend C. C.** 1980. *Strigosella* Boiss. In: Guest E., Townsend C. C. (eds.), *Flora of Iraq* **4**(2). 1031-1037. Baghdad. Iraq.
- [17] **Ball P. W., Akeroyd J. R.** (1993) *Malcolmia* R. Br. In: Tutin T. G., Burges N. A., Chater A. O., Edmondson J. R., Heywood V. H., Moore S. M., Valentine D. H., Walters S. M., Webb D. A. (eds.), *Flora europaea* **2**, 1: 337-339. Cambridge, UK.
- [18] **Akhani H.** (2003) Notes on the flora of Iran: Two new records and synopsis of the new data on Iranian Cruciferae since *Flora Iranica*. *Candollea* **58**: 369-385.
- [19] **Sass J. E.** (1958) *Botanical microtechnique.* (3rd eds). The Iowa state univ. press: 45-60.
- [20] **Guest E.** (1966) *Flora of Iraq.* Ministry of Agriculture, Republic of Iraq. **1**: 1-4.
- [21] **Khalik K. A.** (2005) Morphological studies on trichomes of Brassicaceae in Egypt and taxonomic significance. *Acta Bot. Croat.* **64**:57-73.
- [22] **Fahn A.** (1974) *Plant anatomy.* Second edition. Pergamon press. Oxford, New York. 48.
- [23] **Lawrence G. H. M.** (1955) *An introduction to plant Taxonomy.* The Halcyon press: 131-132.
- [24] **Martin A. C., Barkley. W. D.** (1961) *Seed identification manual.* University of California press: 162-163.
- [25] **Judd, W. S., Campbell C. S., Kellogg E. A., Stevens P. F.** (1990) *Plant systematics.* Sinauer associates, Inc., Sunderland, Massachusetts, U. S. A: 326-328.
- [26] **Abella S. R., Spencer J. E., Hoines J, Nazarchyk. C.** (2009) Assessing an exotic plant surveying program in the Mojave Desert, Clark County, Nevada, USA. *Environ. Monitoring and Ass.* **151**: 221-230.

Author affiliation:

1. Department of Biology, College of Science, University of Baghdad, Baghdad, Iraq.

