

TAXONOMIC STUDIES ON SOME SPECIES OF *CYNARA* L. IN EGYPT

(Received: 18.10.2016)

By

H.S. Abd – El Maksoud and H. R. Habeeb

*Flora and Phyto-taxonomy Research Department, Horticultural Research Institute,
Agricultural Research Center, Giza, Egypt.*

ABSTRACT

The present study was performed on three species of the genus *Cynara* L. in Egypt. These species are; *C. cardunculus* L., *C. cornigera* Lindley (= *C. sibthorpiana* Boiss. & Heldr.) and *C. scolymus* L. (syn. *C. cardunculus* var. *scolymus*). The aim of this study was to distinguish the similarity and dissimilarity among these species. To achieve this, a number of taxonomic evidences reflect the relationships among these species were considered. These evidences were; the morphological description of the whole plant, macro and micromorphological description survey on the leaf and seed surfaces of the studied species. Then two proposed botanical keys were designed.

Key words: *Taxonomy, Cynara, leaf morphology, seed morphology, SEM, botanical key.*

1. INTRODUCTION

Cynara L. Sp. Pl. 2: 827. 1753; Gen. Pl. ed. 5, 359. 1754., (syn. *Arcyna* Wiklundn., *Bourgaea* Coss., *Cynaropsis* Kuntze). Family Compositae Giseke.

Cynara L. is a genus of about 8 species of perennial herbaceous flowering plants (Boulus, 2002), or 11 species (Flann, 2009), native to Mediterranean region Middle East, northwestern Africa, and Canary Islands. (David, 2006). Large leaf, is in a basal rosetae or alternate, usually deeply divided and with spinose lobes or unarmed (Tutin *et al.*, 1976). Corollas narrowly tubular, purple, blue or whitish. Ray limb is unequally 5-lobed, glandular (Boulus, 2002). Achenes are obpyramidal or obovoid-cylindrical, and glabrous (Tutin *et al.*, 1976). Pappus are multiseriata plumose deciduous setae, and connate at the base (Boulus, 2002).

The size and shape of juvenile leaves in particular are important taxonomic characters in *Eucalyptus* with closely related species being differentiated by these traits (Pryor 1976), and Hanan *et al.* (2012) studied the macromorphological and micromorphological characters and ultrastructural variation of the leaf of nine species belonging to genus *Eucalyptus* and the artificial key has been designed to identify the studied species. Ostroumove (1990) studied the stomata types on the leaves of some species belonging to the tribes Coriandreae and Scandiceae

(Umbelliferae) in relation to taxonomy. El-Khanagry (2003) proposed a key to identify 49 species of grasses belonging to 33 genera by using leaves as well as trichomes and cuticular ornamentations. However, the gross morphological characters of the leaf have been used for identification purposes. With increased sophistication of classification systems, it has become increasingly important to have more elaborate means for identification. The leaf has not lost its importance as a taxonomic tool but rather has proved to be more useful when a full understanding of all its characteristics are known and appreciated. The epidermis is the outer layer of cells covering the leaf. It has several functions: the upper and lower surfaces have somewhat different construction and may serve different functions (Hardie, 2009).

Hanan, (2012) proposed keys to design three species of the genus *Oenothera* in Egypt. (*O. biennis*, *O. drummondii* and *O. speciosa*) and studied the similarity and dissimilarity between these species, based on the morphological description of the whole plants representing these species, morphological description and Scanning Electron Microscope (SEM) survey on the leaf, pollen grain and seed surfaces.

The great variations in the morphology and the different ornamentations of the seed coat support the study of taxa delimitation and may solve and facilitate many taxonomic problems. Netolitzky (1926) also confirmed that the

morphology of seed coat surface should be the principle of natural classification of the flowering plants. Voughan (1968) suggested that the structure of the mature seeds, especially the coat structure, can be considered the more taxonomic useful information.

Surface sculpture patterns may aid in solving problems of identity or relationship concerning taxa at various levels (Werker, 1997). The SEM examinations of seed surface features could be applied in taxonomy and there are many characters (e.g. seed coat) that could be used to characterize groups of related species, genera or taxonomic categories up to the sub-family level. Some characters of the micro-morphology and

out to collect the studied species from different localities in Egypt. A total of 3 wild and cultivated taxa of *Cynara* L. were studied (Table 1). The terminology of macro-morphological characters follows Stearn (1983). The detailed surface scan features were examined by using Scanning Electron Microscope (SEM) with different magnifications. Scanning was carried out by JEOL- JSM T 100 Model Scanning Electron Microscope, Central Laboratory, National Information and Documentation Center (NIDoC), Dokki, Giza, Egypt. Descriptive terms for seed and leaf surface scan as cited by Murley (1951) and Claugher (1990).

Table (1) : The studied species and the collection regions.

| No. | species | Habit | Regions |
|-----|--|------------|--|
| 1. | <i>C. cardunculus</i> L. | Cultivated | Experimental field of the Faculty of Agriculture, Cairo University and Agricultural Museum, Giza. and Agricultural Research Center, Giza, Egypt. |
| 2. | <i>C. scolymus</i> L. (= <i>C. cardunculus</i> var. <i>scolymus</i> Wiklund) | Cultivated | Saft Ellaban, Giza, Egypt. |
| 3. | <i>C. cornigera</i> Lindley (= <i>C. sibthorpiana</i> Boiss. & Heldr) | Wild | Orman Garden and Agricultural Museum, Giza, Egypt. |

orientation of epicuticular wax crystalloid are surprisingly of high systematic significance (Barthlott, 1981). More detailed structural information about seeds were obtained by using the Scanning Electron Microscope. However, Yeh and Kakuma (1990) suggested that seed characters; colour, coat patterns, shape, size, outer arils and hilum provide better criteria for species identification and support the taxonomical positions of the taxa.

The aim of the current study was to distinguish the taxonomic relationship between three species of the genus *Cynara* L. in Egypt namely; *C. cardunculus* L., *C. cornigera* Lindley (= *C. sibthorpiana* Boiss. & Heldr.) and *C. scolymus* L. (syn. *C. cardunculus* var. *scolymus*) and to document the species information based on the morphological descriptions of the whole plants representing these species, in addition to the macro and micromorphological descriptions survey on the leaf and seed surfaces of the studied species. Two keys were proposed to identify the individual species.

2.MATERIALS AND METHODS

The fresh leaves and seeds of each species were used in this study. Field trips were carried

3.RESULTS AND DISCUSSION

The species under consideration were studied and the results were gathered according to the following aspects:

- Macromorphological and Scanning Electron Microscope (SEM) descriptions of leaf (upper and lower surfaces) and seed surface for each species.
- Proposed keys to distinguish the studied species based on the macro and micro morphological characters of the leaf and seed of the studied species.

1) *Cynara cardunculus* L., Sp. Pl. 827 (1753).
 It is Herbaceous perennial up to 120 cm high, lanate, stems glabrous to densely arachnoid-tomentose, Massively spined capitulum globose, up to 6-8 cm in diameter. Involucre is often purplish tinged, 4.5–8 × 3–6 cm, excluding spreading phyllary tips, constricted distally or not. Phyllaries are lanceolate to broadly ovate, bases appressed, the fleshy phyllaries are eaten, spreading apices are obtuse to acute or acuminate, spineless or tipped with spines 1–9 mm or truncate, abruptly mucronate, and spineless or minutely spine-tipped. Corollas are blue or purple (rarely white), 3–5 cm; styles are long-exserted (Fig. 1).



Fig. (1): A photograph of *Cynara cardunculus* L.

i) Leaf:

Leaves up to 55 x 37 cm, subcoriaceous, margins deeply 1–2-pinnately lobed or divided to nearly compound, segments are ovate to lanceolate. Spines are 15–35 mm, rigid, yellow, often clustered along petiole and at base of segments. Bright green and short tomentose above, and white-tomentose beneath. Lower leaves are petiolate, the upper most sessile.

Upper epidermis has stomatal type; paracytic with semiraised level and with weak reticulate sculpture pattern. lower epidermis has indistinct stomatal type and sculpture pattern. Trichomes are; non-glandular (digitalis), longer and thinner than hairs in *C. scolymus* Hook. and glandular (vasaka) (Fig. 2).

2) *Cynara cornigera* Lindley in Sibth. & Sm., Fl. Graeca 9:25 (1837).

(= *C. sibthorpiana* Boiss. & Heldr.) is

Herbaceous perennial to 30 cm high, lanate, stems glabrous to densely arachnoid-tomentose. Involucre often 4-5 cm, subglobose, outer phyllary with a slender apical spine 5mm; middle bracts with a cochleariform appendage 8-10 x 10-15mm, abruptly narrowed into an erecto-patent spine 2-5 x 2-4 cm Corollas whitish yellow, capitula usually 5 cm. in diameter. (Fig. 5)

i) Leaf:

Leaves mostly basal, up to 40 x 16 cm, coriaceous, pinnatifid, broadly oblong, glabrous, bright green with pale veins above, white-tomentose with prominent veins beneath, petiolate. Spines are 2-6 mm, and yellow.

Upper epidermis has stomatal type; actinocytic with depressed and superficial level and with ruminant sculpture pattern. Lower epidermis has anomocytic stomatal type with raised level and rugulose sculpture pattern. Trichomes; non-glandular (digitalis), denser than hairs in upper epidermis and glandular (vasaka) Fig. (6).

ii) Achenes:

Pappus plumose, rigid, with tuft of coriaceous hairs. 1.5–2.6 cm. Seed 4-6 x 2.5-3 5mm. in dimensions , shiny, brown, narrowly obovate shaped, smooth to rough surfaced, surface glabrous, favulariate epidermal cell walls,

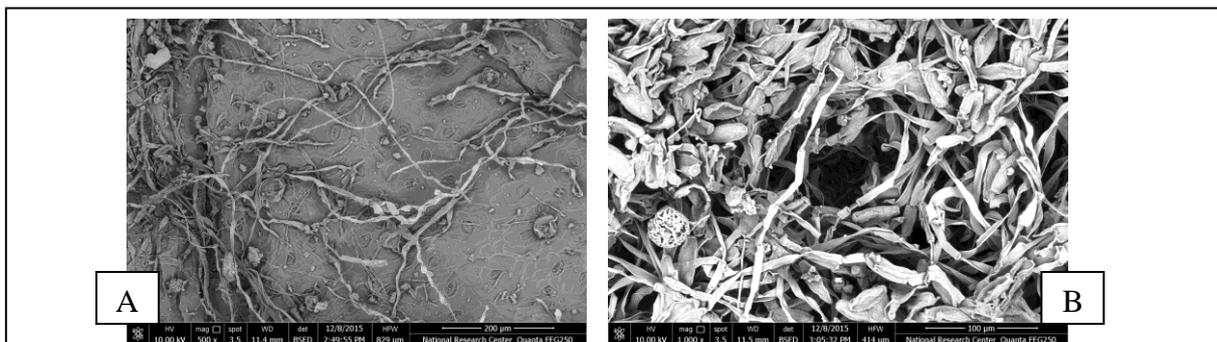


Fig. (2): Scanning electron micrographs of leaf blade of *Cynara cardunculus* L.
A: Surface of upper epidermis, **B:** Surface of lower epidermis.

ii) Achenes:

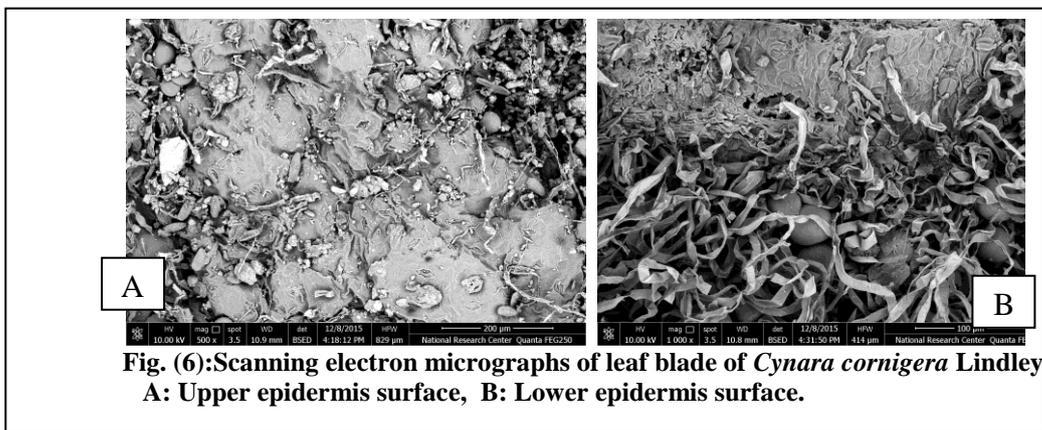
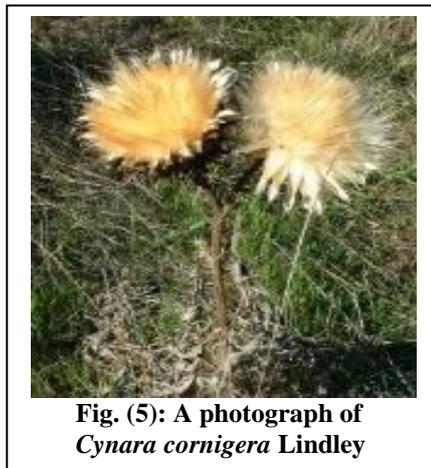
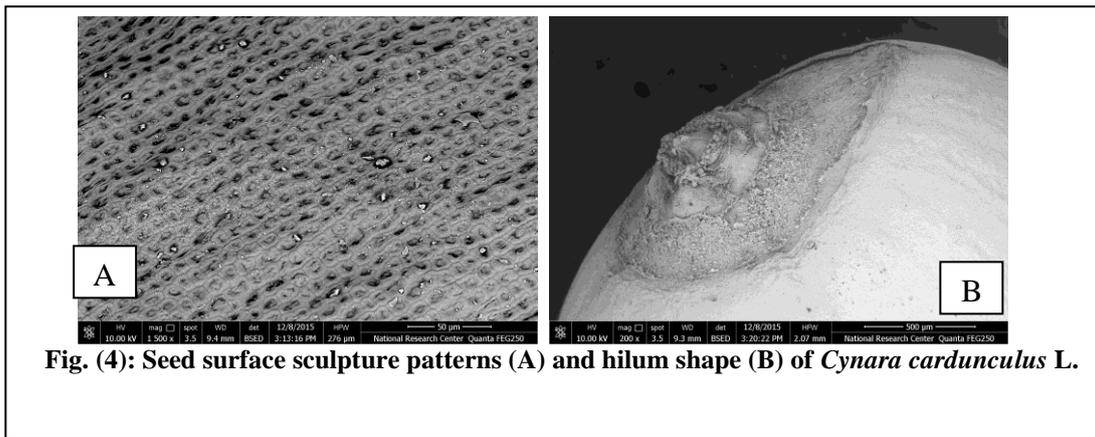
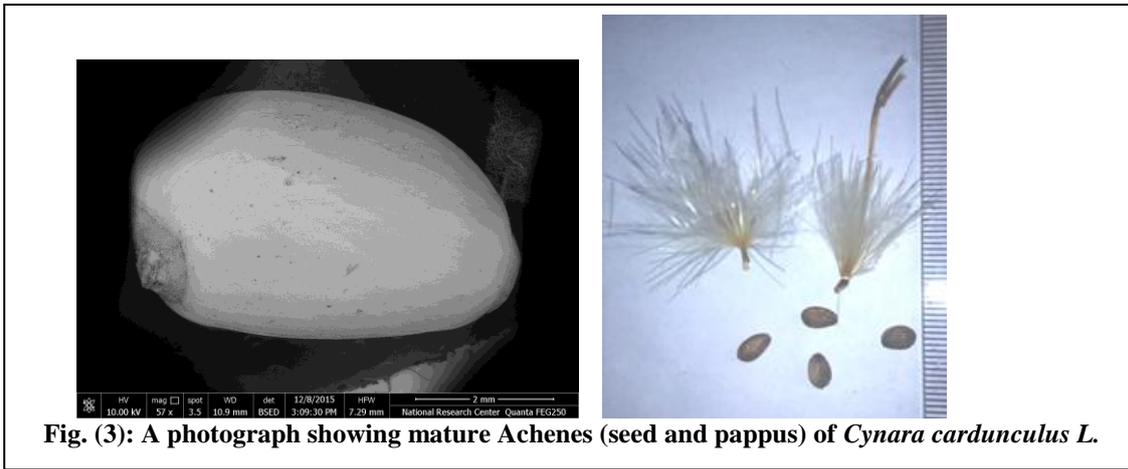
Pappus bristles are 2–4 cm. Seed is 6-8 x 3-4 mm in dimensions , shiny, greenish brown, narrowly obovate shaped, smooth to rough surfaced, surface glabrous, ocellate epidermal cell walls, raised anticlinal walls and Rounded end, usually 4-5 gonals, raised boundaries, outer periclinal walls disintegrated forming square holes. Hilum is conspicuous, subterminal, rounded, white. Base is glabrous and rounded (Fig. 3 & 4).

superficial anticlinal walls and elongate in one direction and usually 4-6 gonals, raised boundaries, outer periclinal walls depressed, concave. Hilum is semiconspicuous, subterminal, rounded, cream. Base is glabrous and rounded (Fig. 7 & 8).

3) *Cynara scolymus* L. Sp. Pl. 827 (1753).

(= *Cynara cardunculus* var. *scolymus* Wiklund).

This vegetable plant, like *Cynara cardunculus* L. but grows to 1.4–2 m high, glabrescent.



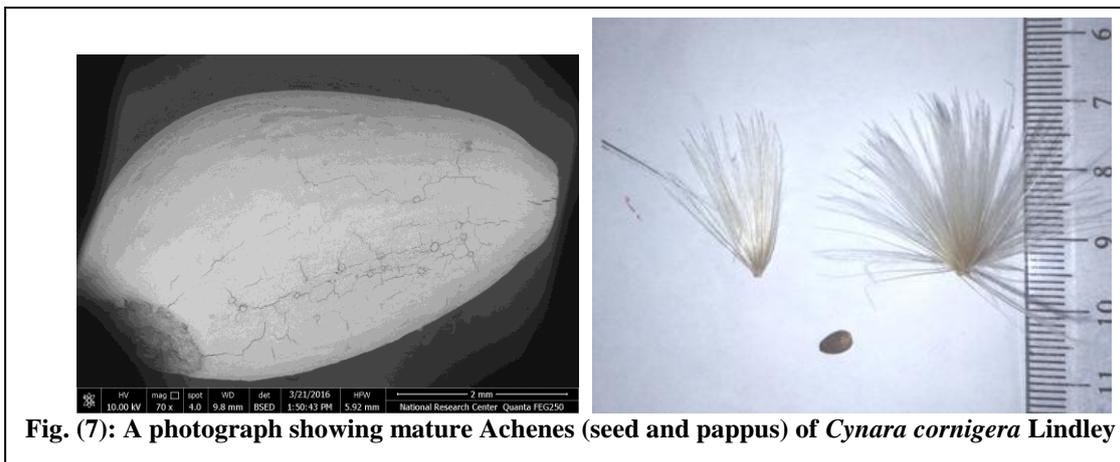


Fig. (7): A photograph showing mature Achenes (seed and pappus) of *Cynara cornigera* Lindley

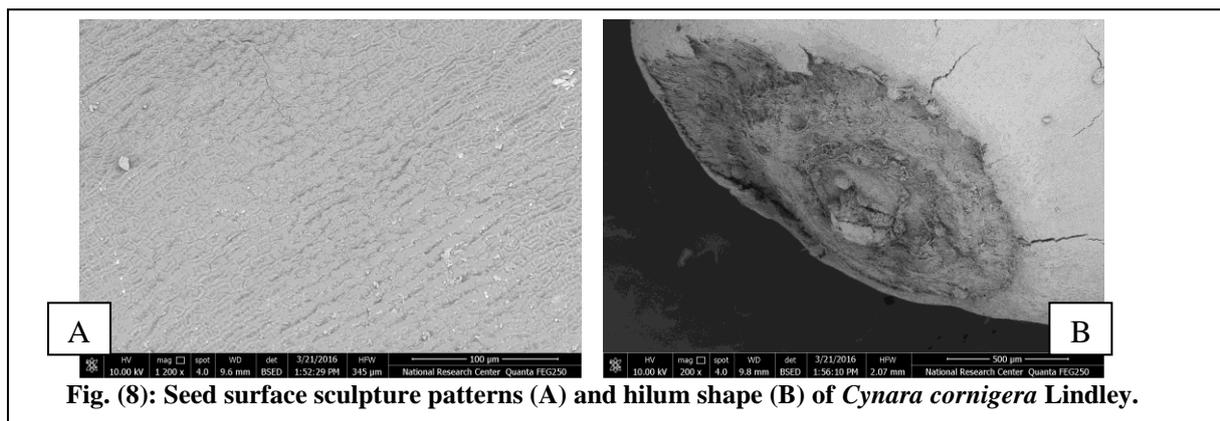


Fig. (8): Seed surface sculpture patterns (A) and hilum shape (B) of *Cynara cornigera* Lindley.

Involucre 5.8-7 x 7-8.4 cm, involucrel fleshy, with a flattish apical appendage; appendage 1.4-4 x 1.2-3.7 cm, ovate to triangular, truncate, cuspidate or sinuate-truncate. The flowers develop in a large head from an edible bud about 8–15 cm in diameter, the individual florets are purple. The edible portions of the buds consist primarily of the fleshy lower portions of the involucrel bracts and the base, known as the "heart"; the mass of immature florets in the center of the bud is called the "choke" or beard. These are inedible in older, larger flowers (Fig. 9).

i) Leaf:

Leaves are up to 80 x 40 cm, soft, pinnatifid, glabrescent above and greyish-tomentose beneath, segments wide unarmed or mucronulate. Lower leaves are petiolate, with the upper most sessile.

Upper epidermis has stomatal type; actinocytic with semiraised and superficial level. Areolate sculpture pattern of upper epidermis. lower epidermis has actinocytic stomatal type and weak reticulate sculpture pattern. Trichomes; non-glandular (digitalis), denser than hairs in upper epidermis and glandular (vasaka) (Fig. 10).

ii) Achenes:

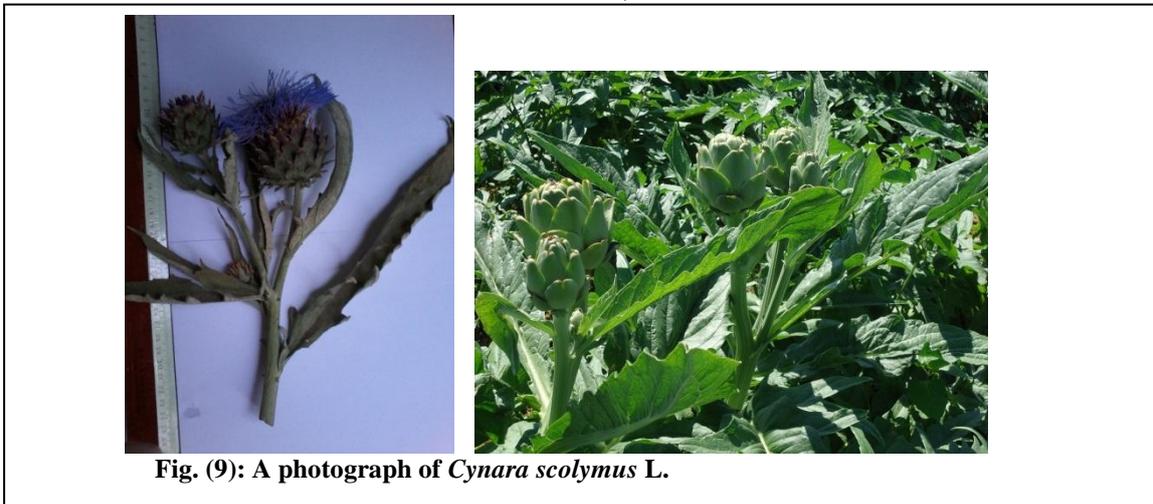
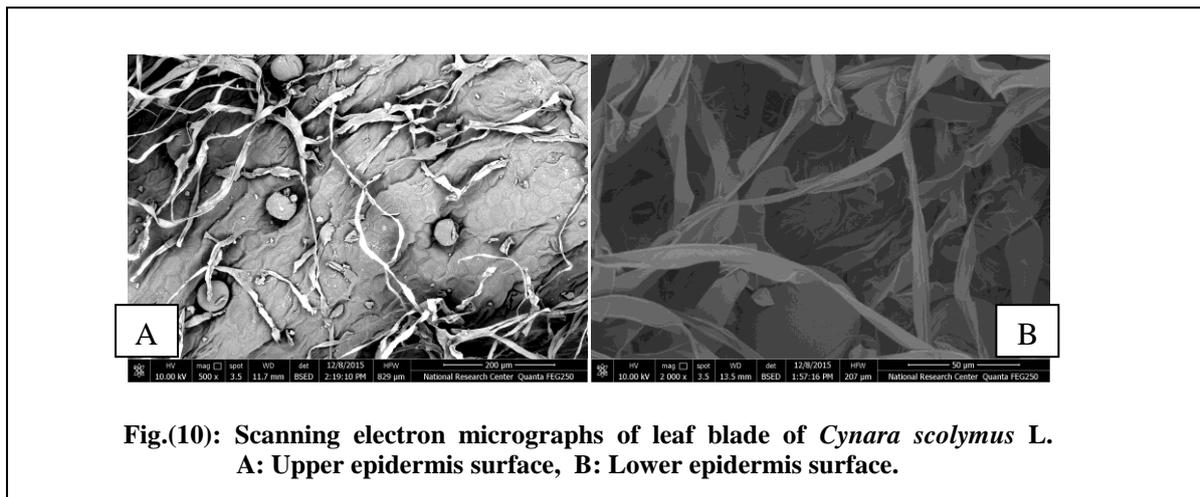


Fig. (9): A photograph of *Cynara scolymus* L.



**Fig.(10): Scanning electron micrographs of leaf blade of *Cynara scolymus* L.
A: Upper epidermis surface, B: Lower epidermis surface.**

Pappus plumose, is rigid, 1.7–6 cm. Seed 5.8-7 x 4-5mm in dimensions , green notched, obovate shaped, glabrous, smooth surfaced, scalariform epidermal cell walls, raised anticlinal walls and elongate in one direction and usually 4-5 gonals, raised boundaries, outer periclinal walls superficial,flat. Hilum conspicuous, terminal, rounded, the same color of seed. Base glabrous and rounded (Fig. 11 & 12).

Proposed Keys:

The following proposed keys were designed to distinguish and identify the studied species. The skeleton of these keys are based on; 1) the macro

and micro morphological characters of the leaf. 2) the macro and micro morphological characters of the seed.

1) Key based on the macro and micro morphological characters of the leaf of the studied species.

A) Leaf-segments are unarmed or mucronulate. Leaves up to 80 x 40 cm, soft, glabrescent above and greyish-tomentose beneath. Upper epidermis with stomatal type; actinocytic, areolate sculpture pattern. lower epidermis has actinocytic stomatal type and weak reticulate sculpture pattern..... *Cynara scolymus*

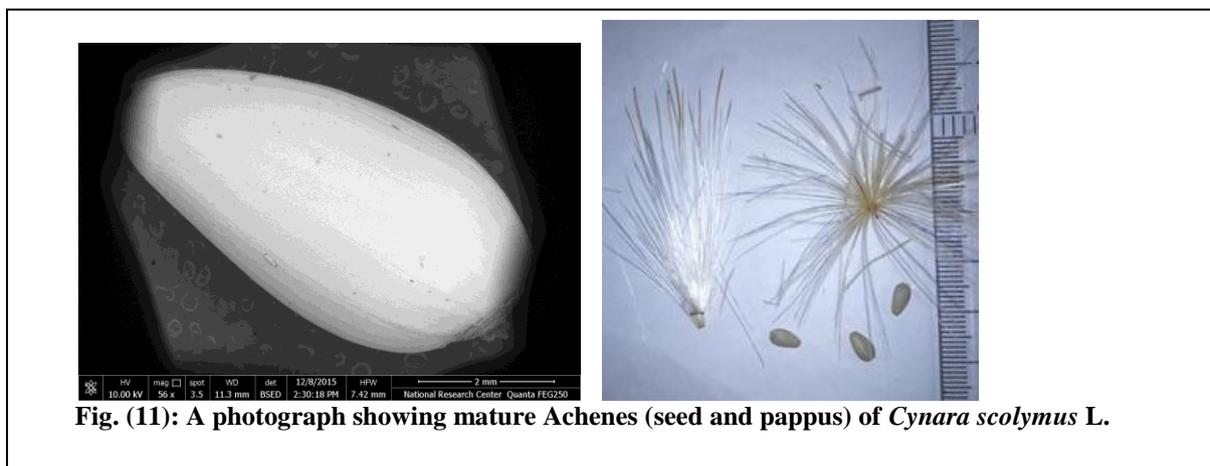


Fig. (11): A photograph showing mature Achenes (seed and pappus) of *Cynara scolymus* L.

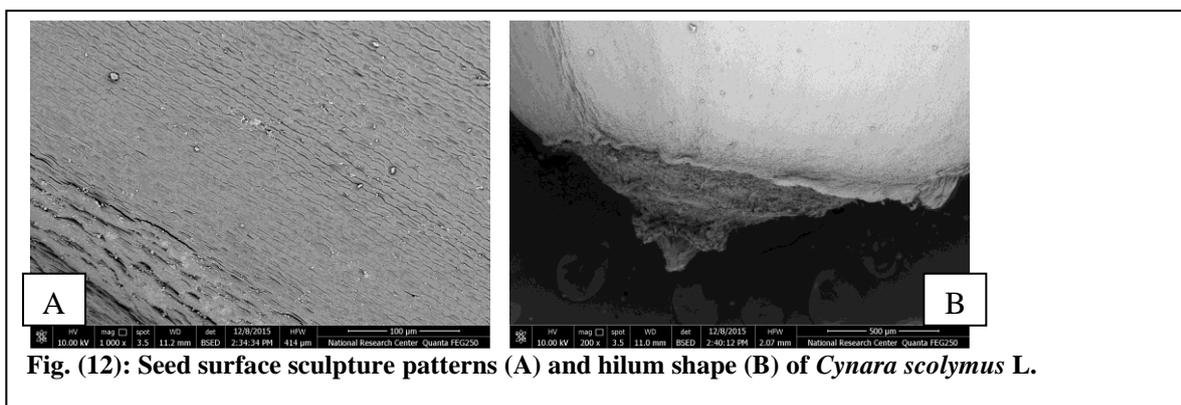


Fig. (12): Seed surface sculpture patterns (A) and hilum shape (B) of *Cynara scolymus* L.

AA) Leaf-segments Spiny.

a. Spines 15–35 mm, often clustered along petiole and at base of segments. Leaves up to 55 x 37 cm, subcoriaceous. Upper epidermis has stomatal type; paracytic and reticulate sculpture pattern. lower epidermis has indistinct stomatal type and sculpture pattern *C. cardunculus*

aa. Spines 2-6 mm. Leaves mostly basal, up to 40 x 16 cm, coriaceous, petiolate. Upper epidermis has stomatal type; actinocytic and ruminant sculpture pattern. Lower epidermis has anomocytic stomatal type and rugulose sculpture pattern *C. cornigera*

2) Key based on the macro and micro morphology of seed of studied species.

A. Seed green notched. Hilum the same color of seed. Scalariform epidermal cell walls, raised anticlinal walls and elongate in one direction and usually 4-5 gonals, raised boundaries, outer periclinal walls superficial, flat.
..... *Cynara scolymus*

AA. Not so.

a. Seed greenish brown. Hilum white. Ocellate epidermal cell walls, raised anticlinal walls and Rounded end, usually 4-5 gonals, outer ericlinal walls disintegrated forming square hole
..... *C. cardunculus*

aa. Seed shiny, brown. Hilum cream. Favulariate epidermal cell walls, superficial anticlinal walls and elongate in one direction and usually 4-6 gonals, outer periclinal walls epressed,concave.
..... *C. cornigera*

4. REFERENCES

Barthlott W. (1981). Epidermal and seed surface characters of plants: Systematic applicability and some evolutionary aspects. *Nordic J. Bot.*, (1): 345-355
 Boulos L. (2002). *Flora of Egypt. (Verbebaseae – Compositae)*, Vol.3, Al Hadara publishing, Cairo, Egypt. 373p.
 Claugher D. (1990). *Scanning Electron Microscopy in Taxonomy and Functional Morphology. The Systematics Association Special*, 41:70-94.
 David J. K. (2006). *Flora of North America Magnoliophyta: Asteridae (in part): Asteraceae, part 1,2,3). Vol. 19, 20 and 21. Printed in Oxford University press. 690P.*

El-Khanagry S.S.G. (2003). Field key for identification of some Egyptian grasses by vegetative characters. The 2nd Conference of Agriculture & Biological Research Division, National Research Center, Egypt, (3): 547-557.
 Flann C. (Ed). (2009). *Global Compositae Checklist*. [http:// WWW. Compositae. Org/ Checklist](http://WWW.Compositae.Org/Checklist) [accessed 21 Nov. 2011].
 Hanan S. Abd–El Maksoud (2012). Morphological studies on leaf , Pollen grain and Seed of genus *Oenothera* L. in Egypt by using Scanning Electron Microscope (SEM). *The Bull., Fac. Agric., Cairo Univ.* 63; 432-438 .
 Hanan S. Abd – El Maksoud ; Mahmoud M. and Nermeen T. Shanan (2012) Leaf surface features as taxonomic evidences to identify some species of genus *Eucalyptus* in Eygpt by using Scanning Electron Microscope. *J. Product. and Development (Agricultural Research)*, vol. 17 , (2):, pp.239-255.
 Hardei J. (2009). Autum leaves seen through herbivour eye. *Proc. Royal Soc. Biol. Sci.*, 276: 121-127.
 Murley M.R. (1951). Seed of the Cruciferae. *Amer. Midl. Nat.*, 46: 1-18.
 Netolizky F. (1926). *Anatomic der Angiospermen. Bd. 10 in Hand buch der Pflanzenanatomie. Abt. , 2nd Edit. K. Linbauer, (Pub.) Berlin 845P.*
 Ostroumove T.A. (1990). Stomatal types in the Umbelliferae in relation to taxonomy of tribe Conianreae & Scandiceae. *Fedds Rept.* 101 (7-8): 409-416.
 Pryor L. D. (1976). *The biology of Eucalyptus.* Edward Arnold, (Pub.), London, U. K. 82P.
 Stearn W.T. (1983). *Botanical Latin, 3rd Edit.* David & Charles Inc.(Pub.), USA. 553P.
 Tutin T.G.; Heywood, V.H.; Burges, N.A.; Valentine D. H., Walters S.M. and Webb D. A. (1976). *Flora Europaea (Plantaginaceae to Compositae) Vol 4. Cambridge Univ. Press (2nd edit.) 505P.*
 Voughan J.G. (1968). Seed anatomy and taxonomy. *Proc. Linn. Soc., London*, 179: 251-255
 Werker E. (1997). *Seed Anatomy. Gebrvder Borntraeger (Pub.), Berlin, Germany. 359P.*
 Yeh M. S. Y. and Kakuma, M. (1990). Bambara bean. *Tropical Leguminous resources (11). J. Agric. Assoc. China*, 138: 3-15.

دراسات تقسيمية على بعض أنواع جنس الخرشوف في مصر

حنان سلامة عبدالمقصود- حفيظ روفانيل حبيب

قسم بحوث الفلورة وتصنيف النباتات – معهد بحوث البساتين – مركز البحوث الزراعية – مصر.

ملخص

اشتملت هذه الدراسة على ثلاثة أنواع من جنس الخرشوف موجودة في مصر وهي :

C. cardunculus L., *C. cornigera* Lindley (= *C. sibthorpiana* Boiss. & Heldr.) and *C. scolymus* L. (syn. *C. cardunculus* var. *scolymus*).

وذلك بهدف توضيح مدى التشابه أو الاختلاف بين تلك الأنواع وقد تم استخدام عدد من الأدلة التصنيفية وهي الصفات المورفولوجية للنبات وصفات الورقة والبذرة الماكرومورفولوجية والميكرومورفولوجية باستخدام الميكروسكوب الإلكتروني الماسح وتم عمل مفتاح نباتي للأنواع تحت الدراسة كمحاولة عمل توثيق وحصر معلوماتي لأنواع الخرشوف الموجودة في مصر.

المجلة العلمية لكلية الزراعة – جامعة القاهرة - المجلد (67) العدد الرابع (أكتوبر 2016) : 314-307.