

A TAXONOMIC STUDY OF THE GENUS *TRIBULUS* L. IN EGYPT

I- MORPHOLOGICAL FEATURES

[11]

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ABSTRACT

This work aims at classifying the genus *Tribulus* which is represented in Egypt by 7 taxa (6 species & one variety) viz.: *Tribulus terrestris*, *T. terrestris* var. *bicornutus*, *T. pentandrus*, *T. macropterus*, *T. megistopterus*, *T. mollis* and *T. kaiseri* according to the current classical morphological features including those of flower which can lead to a correct taxonomic decision. The work includes detailed comparative vegetative and reproductive morphology of the studied taxa, while drawings representing the extracted results are tried into cumulative plates. Also an artificial indented dichotomous key for the studied taxa is constructed. The key easily differentiated the pentacyclic flowered taxa from the tetracyclic in 2 separated collections. The 1st is composed of 5 taxa in which; nature of pericarp (bony or herbaceous), leaflet pairs into large leaf (7 or 6), calyx (persistent or deciduous), anther connection (basi- or dorsifixed) and others are found effective in identification. On the other hand; calyx imbrication (quincuncial or ascending) and stigma (persistent or deciduous) are used in separating the 2 spp. within the 2nd collection.

Key words: Genus *Tribulus* L., Morphological features

INTRODUCTION

Tribulus of the family Zygophyllaceae is a **Linnaean** genus (1753) described by 4 species (*Tribulus terrestris*, *T. lanuginosus*, *T. cistoides* and *T. maximus*) into class Decandria and order Monogynia.

Oliver, (1868) divided the spp. of *Tribulus* into 2 groups according to the characters of ovary and stigma. **Muschler**, (1912) classified them into 3 gps. according to the length of petals relative

to calyx. **Zohary**, (1972) stated that the fruit is a schizocarp, mericarps 5, indehiscent, often separating from axis at maturity, indurated, prickly tuberculated or winged. Seeds solitary, obliquely pendulous, coat membranous and endosperm absent.

On the other hand **Engler and Prantle**, (1897) and **Tackhohm**, (1974) recognized 3 gps. of *Tribulus* spp. according to the characters of carpellary appendages (1- spiny with 2-4 spines for each carpel,

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2- with two lateral wings, 3- spineless and wingless). Also **Tackholm, (1974)** recorded 5 spp. one subsp. and 3 varieties of the genus in Egypt (*T. ochroleucus*, *T. pterocarpus*, *T. longipetalus*, *T. longipetalus* subsp. *macropterus*, *T. pentandrus*, *T. terrestris*, *T. terrestris* var. *orientalis*, *T. terrestris* var. *robustus* & *T. terrestris* var. *bicornutus*).

Abdul Ghafoor (1977) recorded that the flowers are solitary, axillary or pseudo-axillary, pedicellate, actinomorphic, pentamerous, yellow, rarely white, disc annular, fleshy and 10 lobed. Sepals 5, ovate-lanceolate, pubescent, margins membranous caducous or persistent. Petals 5, patent, obovate, obtuse to \pm lobed at apex or fugacious. Stamens 10 in 2 whorles, rarely 5, inserted between the lobes of the disc, without scaly appendages at base, 5 antisealous ones shorter, 5 adnate to the base of petals, anthers subbasifixed. Ovary sessile, ovoid or globose, 5-lobed, densely covered by long white appressed hairs, 5-loculed, each locule 2-5 ovuled, style stout – cylindrical, 5-ridged, 1-4 mm long, stigma 5 rayed, ovoid – capitate.

El-Hadidi, (1978) recorded that *Tribulus* comprises about 25 spp. mostly paleotropic while **Hosni, (1978)** revised 13 spp., 2 subspp. and 6 varieties of the genus in Egypt & Arabia and added *T.kaiseri* as a new record sp. to Egypt.

Townsend, (1980), showed that *Tribulus* spp. are either annual or perennial hairy herbs with opposite pinnate leaves, one bigger than the other at each node.

Boulos, (1995) recorded 7 spp. one subsp. and 3 varieties of the genus in Egypt (*T. ochroleucus*, *T. pentandrus*, *T. macropterus* var. *macropterus*, *T. macropterus* var. *collenetteae*, *T. terrestris*, *T.*

parvispinus var. *parvispinus*, *T. spurius*, *T. megistopterus* subsp. *pterocarpus*, *T. bimucronatus*, *T. mollis* and *T. kaiseri*).

This paper is the first in a study of 2 parts, in this part a comparative study of morphological features of seven taxa of the genus *Tribulus* is carried out. In the second part, the histological features are going to be studied. The obtained results will be used as taxonomic information to suggest a new proposed system about the taxonomy of *Tribulus*.

MATERIAL AND METHODS

The present study is based on fresh and dried materials collected from different localities in Egypt. A list of the studied specimens is given in Table (1). Specimens were kept in the herbarium of the Faculty of Science (Girls), Al-Azhar Univ., Cairo.

Foliar and floral details were examined with the aid of binocular stereomicroscope under incident light. Drawings representing the vegetative and reproductive morphology are original and recorded in cumulative plates (I-III). These were presented in a certain way in order to explain the most important characters analysed.

RESULTS AND DISCUSSION

(1) Vegetative Morphology: PLATE I

Whole Plant and Leaf Morphology

a- Whole Plant: Pl., I Fig. 1

The growth form varies between annual and biennial white pubescent herbs that have apical robust procumbent branches of sympodial dichasium growth. Annual herbs are: *Tribulus terrestris*;

Table 1. List of the collected specimens

| Specimens (Taxa) | Locality | Date of collection |
|---|-------------------------------|--------------------|
| 1- <i>Tribulus terrestris</i> , L. | Cairo, Tayaran st., Nasr City | 20-6-1997 |
| 2- <i>T. terrestris</i> var. <i>bicornutus</i> (Fisch et Mey) Hadidi. | Cairo, Tayaran st., Nasr City | 20-6-1997 |
| 3- <i>T. pentandrus</i> , Forsskal.* | Kurkur Oasis (Western Desert) | 18-2-1964 |
| 4- <i>T. macropterus</i> , Boiss.* | Red Sea | 29-2-1977 |
| 5- <i>T. megistopterus</i> , Kralik.* | Bir Abra q (Eastern Desert) | 13-1-1930 |
| 6- <i>T. mollis</i> , Ehrenb.* | Kurkur Oasis (Western Desert) | 12-2-1964 |
| 7- <i>T. kaiseri</i> , H. Hosni.* | Wadi El Siq (Ras Sidr, Sinai) | 6-5-1927 |

An* mark indicates herbarium specimen (Cairo Univ.).

Fig. (1), *T. terrestris* var. *bicornutus* and *T. kaiseri* while the biennials are: *T. macropterus*, *T. megistopterus* and *T. mollis* in addition to *T. pentandrus* which is both annual & biennial herb. These may be semi-erect (*T. megistopterus*) or prostrate (the remainder spp.). Branches may be short; ≤ 25 cm length (*T. terrestris* var. *bicornutus*, *T. kaiseri*), long; >50 cm length (*T. terrestris* var. *bicornutus*, *T. pentandrus*) and medium; ≤ 50 cm length (the remainders), either sparingly hairy (*T. megistopterus*, *T. mollis*) or densely (the remainders).

b- Leaf Morphology : Pl. I, Figs. 2-4

Leaves are usually opposite, petiolate, stipulate, unequal sized at each node and abruptly paripinnate. Large leaf may have 7 pairs of leaflets (Fig. 2,a) in *T. terrestris*, *T. megistopterus* but mostly 6-paired (Fig. 2,b) in the remainders. Small leaf may be 5-paired (Fig. 2,a) in *T. terrestris*, 3-paired (Fig. 2,b) in *T. me-*

gistopterus, *T. mollis* and 4-paired (Fig. 2,c) in the remainders. Stipules entire and acute, may be; broadly lanceolate (Fig. 3,a) in *T. macropterus*, ovate – lanceolate in *T. pentandrus* while long ovate (Fig. 3,b) in the remainders. Leaflet usually entire, subsessile, asymmetric at base and elongate, may be; ovate-acute (Fig. 4,a) in *T. terrestris*, *T. megistopterus* & *T. kaiseri* or elliptic lanceolate-acuminate (Fig. 4,b) in *T. terrestris* var. *bicornutus*, *T. pentandrus*, *T. mollis* and or acute in *T. macropterus*.

(2) Reproductive Morphology: Plates: II & III

a- Flower characters: PLATE II

It is usually solitary, ebracteate, pedicellate, pseudoaxillary (Fig. 1), distinct and actinomorphic, either tetracyclic (Fig. 2,a) in *T. pentandrus* & *T. kaiseri* or pentacyclic (Fig. 2,b) in the remainders. Calyx descending imbricate (Fig. 3,a) in

Fig. 1. Whole plant, Fig. 2. Leaflet pairs into large and small leaves,
Fig. 3. Stipule shapes, Fig. 4. Leaflet shapes

Fig. 1. Flower position,
Fig. 2. Floral cycles,
Fig. 3. Fl. Diagrams (sepal & petal aestivations)

Fig. 4. Sepal shapes, Fig. 5. Petal characters, Fig. 6. Stamen position
& anther lobes length, Fig. 7. L.S. in ovary, Fig. 8. Stigmatic shapes

T. megistopterus, ascending in *T. pentandrus*, valvate (Fig. 3,b) in *T. terrestris* var. *bicornutus*, *T. macropterus* and quincuncial (Fig. 2,b) in the remainders. Sepals may be obovate (Fig. 4,a) in *T. terrestris*, ovate in *T. terrestris* var. *bicornutus* and lanceolate acuminate (Fig. 4,b) in the remainders, sometimes deciduous (Fig. 3,a) in *T. megistopterus* while persistent in the remainders.

Corolla; usually imbricate, either creamy (*T. kaiseri*) or yellow (the remainders). Petals may be quincuncial (Fig. 3,b) in *T. macropterus*, descending (Fig. 2,b) in *T. terrestris* and convolute anticlockwise (Fig. 3,a,c) in the remainders. They are always obovate, either broad-based (Fig. 5,a) in *T. terrestris*, *T. terrestris* var. *bicornutus*, *T. megistopterus* or narrow based (Fig. 5,b) in the remainders, spatulate in *T. terrestris*, *T. terrestris* var. *bicornutus* and flattened in the remainders. Apices may be truncate – wavy (Fig. 5,c) in *T. megistopterus*, emarginate in *T. terrestris*, *T. pentandrus* and obtuse (Fig. 5,d) in the remainders.

Androecium; either one whorled (Figs. 2a, 3c) in *T. pentandrus*, *T. kaiseri* or two (the remainders). Stamen usually obdiplostimonous with the outer whorl attached to petal base (Fig. 6,a), introrse and open lengthwise. Anther lobes may be equal (Fig. 6,a) in *T. terrestris*, *T. macropterus*, *T. mollis* but unequal (Fig. 6,b) in the remainders, dorsifixed (*T. terrestris*, *T. mollis*) subbasifixed in *T. macropterus* and basifixed (the remainders).

Gynoecium syncarpous, usually subtended by an annular disc and densely covered by white appressed hairs. Ovary

sessile, superior with unequal locules except *T. megistopterus*, *T. macropterus* (Fig. 3, a&b) which have equal locules (each with 2-5 hemitropus ovules on axile placentation (Fig. 7). Style stout cylindrical, 5-ridged, 1-4 mm long, while stigma, either persistent (*T. kaiseri*) or deciduous (the remainders), may be conical (Fig. 8,a) in *T. macropterus*, cylindrical (Fig. 8,b) in *T. pentandrus*, *T. mollis*, *T. kaiseri* and obovate (Fig.8,c) in the remainders.

b- Fruit and Seed : PLATE III

Fruit: Pl. III, Figs. 1,2.

Usually a schizocarpic capsule, may be discoid (Fig. 1,a) with a spiny form (i) in *T. terrestris*, *T. terrestris* var. *bicornutus* and a hairy form (ii) in *T. kaiseri*, ± broadly ovate (Fig. 1,b) in *T. pentandrus* and subglobose (Fig. 1,c) in the remainders. Pericarp bony in *T. terrestris*, *T. terrestris* var. *bicornutus* and herbaceous in the remainders.

Mericaip (Fig. 2) often separated from axis at maturity with the expocarp; winged (Fig. 2,a) in *T. macropterus*, *T. megistopterus*, tubercled (Fig. 2,b) in *T. kaiseri*, *T. mollis* and spiny (Fig. 2,c) in the remainders.

- Seed: Pl. III, Fig. 3.

Always solitary, obliquely pendulous, usually obovate, testa membranous, either grooved (Fig. 3,a) in *T. terrestris* or entire (Fig. 3,b) in the remainders. Colour ranged between brown (*T. pentandrus*, *T. megistopterus*, *T. kaiseri*) or creamy (the remainders).

Fig. 1. Fruit capsule shape,
Fig. 2. Mericarp surface,
Fig. 3. Seed testa

KEY FOR SPECIES

- A- Flower pentacyclic
- B- Pericarp bony, plant annual
- C- Large leaf with 7 pairs of leaflets, corolla descending imbricate, anther lobes equal and dorsifixed*T. terrestris*
- CC- Large leaf 6-paired, corolla anticlockwise, anther lobes unequal and basifixed*T. terrestris*
var. *bicornutus*
- BB- Pericarp herbaceous, plant biennial
- D- Calyx persistent, petals narrow based, seeds creamy
- E- Ovary with equal locules*T. macropterus*
- EE- Ovary with unequal locules*T. mollis*
- DD- Calyx deciduous, petals wide based, seeds brown *T. megistopterus*
- AA- Flower tetracyclic
- F- Calyx quincuncial, stigma persistent *T. kaiserii*
- FF- Calyx ascending, stigma deciduous*T. pentandrus*

This result is in conformity with **Oliver (1868)** who divided the spp. of *Tribulus* into 2 gps. according to the characters of ovary and stigma.

REFERENCES

- Abdul Ghafoor, A. (1977).** *Zygophyllaceae in Flora of Libya*. No. 38, pp. 39-47. Jafri, S.M.H. & A. El-Gadi (eds.). Bot. Dept., Fac. Sci., Al-Faateh Univ. Tripoli, Libya.
- Boulos, L. (1995).** *Flora of Egypt* (Checklist), pp. 81-82. Al-Hadara Publishing, Cairo, Egypt.
- El-Hadidi, M.N. (1978).** A Proposed Classification for the Genus *Tribulus* L. *Taackholmia*, No. 9, pp. 59-66. Publ. Cairo Univ., Giza, Egypt.
- Engler, A. and K. Prantle, (1897).** *Die Naturlichen Pflanzenfamilien, Teil 3 Abteilung (4 und 5)*, pp. 86-87. Engelmann, Leipzig, Germany.
- Hosni Hasnaa, A. (1978).** Revision of the Genus *Tribulus* L. Sections: *Alata* and *Inermis* in Egypt and Arabia. pp. 3-53. M.Sc. Thesis, Bot., Dept., Fac. Sci., Cairo, Univ., Giza, Egypt.
- Linnaeus, C. (1753).** *Species Plantarum*. Ed.1, p. 386. Holmiae, Sweden.
- Muschler, R. (1912).** *A Manual Flora of Egypt*, Vol. 1, pp. 572-574. R. Friedlander & Sohn, Berlin, Germany.
- Oliver, D. (1868).** *Flora of Tropical Africa*, Vol. 1, pp. 283-285. Ashford, London, Great Britain.
- Tackholm, Vivi (1974).** *Students' Flora of Egypt*, Ed. 2, pp. 311-313, Publ., Cairo Univ., Giza, Egypt.
- Townsend, C.C. (1980).** *Flora of Iraq*, Vol. 1, pp. 289-293. Ministry of Agriculture and Agrarian Reform Baghdad. Republic of Iraq.
- Zohary, M. (1972).** *Flora Palaestina*, Vol. 2, pp. 255-256. Israel Academy of Sciences and Humanities, Jerusalem.

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دراسة تصنيفية لجنس تريبيولس (الفصيلة الزيجوفيللية) فى مصر أولاً: الصفات المورفولوجية

[11]

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فرق بسهولة بين النباتات خماسية المحيطات الزهرية pentacyclic (وعدها خمسة) وتلك الرباعية tetracyclic (وعدها اثنتان). وقد اختلفت النباتات خماسية المحيطات الزهرية فيما بينها بالنسبة لطبيعة الغلاف الثمرى pericarp (عظمى bony أو عشبي herbaceous)، عدد أزواج الوريقات leaflet pairs بالورقة الكبيرة large leaf أو الكأس (دائم persistant أو متساقط * deciduous) وغيرها.

أما النوعان رباعيا المحيطات الزهرية فقد تعرفنا عن طريق الاختلاف فى تراكب الكأس calyx imbrication (قوقعى quincuncial أو تصاعدى ascending) ودوام أو تساقط الميسم stigma.

يهدف هذا البحث إلى تصنيف جنس تريبيولس *genus Tribulus L.* أو أبوجريسة النامى فى مصر والممثل بسبعة فئات تصنيفية من ستة أنواع وصنف:

(*Tribulus terrestris*, *T. terrestris* var. *bicornutus*, *T. pentandrus*, *T. macropterus*, *T. megistopterus*, *T. mollis* & *T. kaiseri*).

على أساس الصفات المورفولوجية التقليدية مشتملة على تلك الخاصة بالزهرة والتي من الممكن أن تؤدي إلى قرار تصنيفى سليم.

اشتمل البحث على دراسات تفصيلية مقارنة لمختلف تراكيب الشكل الظاهرى والتي عبر عنها برسومات دقيقة داخل لوحات مجمعة cumulative plates ، كما تم استخلاص مفتاح تعريفى صناعى ومسند

أ.د. قاسم فؤاد السحار

تحكيم: أ.د. سامى عبد القوى