

## Taxonomic Evaluation of Euphorbiaceae *sensu lato* with Special Reference to Phyllanthaceae as a New Family to the Flora of Egypt

Abdel Aziz Fayed<sup>1</sup>, Mohamed Soliman<sup>2</sup>, Ahamed Faried<sup>1</sup> and Mona Hassan<sup>1</sup>

<sup>1</sup>Botany and Microbiology Department, Faculty of Science, Assiut University, Assiut, Egypt.

<sup>2</sup>Botany Department, Faculty of Science, Helwan University, Helwan, Egypt.

(Corresponding author: Mona Hassan)

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**ABSTRACT:** Phyllanthaceae is one of five segregates families of Euphorbiaceae *sensu lato* according to Angiosperm Phylogeny Group system. It shares some morphological characters with Euphorbiaceae *sensu stricto* such as unisexual flowers, syncarpous ovary, axile-apical placentation and absence of pistillode. A critical taxonomic revision of six genera and 10 taxa belonging to both Phyllanthaceae and Euphorbiaceae in Egypt is presented. The study was carried out on herbarium specimens as well as fresh materials of the genera: *Andrachne*, *Flueggea*, *Phyllanthus* (Phyllanthaceae) and *Ricinus*, *Mercurialis*, *Jatropha* (Euphorbiaceae). Nomenclature, type citations and keys to the genera and all species are provided. Synonyms, ecology, regional and worldwide distribution, phenology, list of representative examined specimens together with line drawing for leaves, stipules, staminate and pistillate flowers, female calyx and fruits are including for each taxon. The results reveal that Phyllanthaceae differ mainly from Euphorbiaceae in absence of embedded laminar glands, having simple leaves (unlobed), two ovules per locule and the seeds being ecarunculate.

**Keywords:** *Andrachne*, *Flueggea*, *Jatropha*, *Mercurialis*, *Phyllanthus*, *Ricinus*.

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### INTRODUCTION

Euphorbiaceae is one of the sixth largest plant families of Angiosperms after Orchidaceae, Asteraceae, Fabaceae, Rubiaceae and Poaceae (Christenhusz and Byng, 2016). It represents a range of vegetative growth that may equal or increase (branching and habit) more than other angiosperm families (Hallé, 1971). Euphorbiaceae includes around 8000-9000 species in 340 genera and it is widespread throughout the world, it far from the polar zones, and it is strongly represented in the tropical regions of the world (Radcliffe-Smith, 1980, Secco *et al.*, 2012).

Many authors studied the taxonomy of this family (Jussieu, 1824, Baillon, 1858, Müller 1873, Bentham, 1878, Bentham 1880, Pax and Hoffmann, 1914, Pax and Hoffmann, 1922, Pax and Hoffmann, 1931, Jablonski, 1967, Hutchinson, 1969, Webster, 1975, Webster, 1987, 1994a, 1994b, 2014, Radcliffe-Smith, 2001). While Webster (1994b) carried out a significant contribution to the family, he was divided Euphorbiaceae *s.l.* into five subfamilies based on different morphological characters such as the number of ovules per ovary locule, type of indumentums,

occurrence of latex and pollen morphology: Phyllanthoideae, Oldfieldioideae, Acalyphoideae, Crotonoideae and Euphorbioideae. Webster (1994a) stated the difficulty to summarize the overall distributional history of subfamilies of Euphorbiaceae *s.l.* However, the most genera related to Phyllanthoideae are tropical but few taxa are mainly in temperate regions, it comprises approximately 10 tribes including 60 genera (Webster, 1994b). Acalyphoideae consider one of the most complex and large subfamily in Euphorbiaceae *s.l.*, it is composed of 116 genera (Webster, 1994b). Crotonoideae includes around 74 genera while Euphorbioideae have more or less 46 genera (Radcliffe-Smith, 2001; Webster, 1987, 1994b). Recently, the Angiosperm Phylogeny Group (APG IV, 2016) based on Wurdack *et al.* (2004) was recognized five lineages of Euphorbiaceae *s.l.* at family level: Phyllanthaceae, Putranjivaceae, Pandaceae, Picrodendraceae and Euphorbiaceae *sensu stricto*. Classification of these five families was mainly based on the most advanced molecular taxonomy in conjunction with the morphological data that proposed by Webster (1994b).

More recent studies (Wurdack and Chase, 1996, Soltis *et al.*, 1997, Savolainen *et al.*, 2000a, Savolainen *et al.*, 2000b, Soltis *et al.*, 2000, Wurdack *et al.*, 2004, Kathriarachchi *et al.*, 2005, Samuel *et al.*, 2005, Wurdack *et al.*, 2005, Hoffmann *et al.*, 2006, Kathriarachchi *et al.*, 2006, Wurdack and Davis, 2009) confirmed the newly recognized APG families with regards to molecular studies using DNA sequencing data as well as morphological characters. The first comprehensive study of Phyllanthaceae as one of five segregates of Euphorbiaceae *s.l.* was published by Wurdack *et al.* (2004). Furthermore, the separation of Phyllanthaceae was early supported by several studies on different research levels: Seed coat anatomy (Corner, 1976, Meeuse, 1990, Huber, 1991), seed-protein and serological data (Vogel, 1986, Jensen *et al.*, 1994), chemotaxonomy (Beutler *et al.*, 1996, Hegnauer, 1977) and phytochemistry (Seigler, 1994). Recently, Moawed *et al.* (2015) recommended segregation of Phyllanthaceae from Euphorbiaceae *s.l.* based on micro and macro morphological as well as vein-architectural characters.

The number of genera and species represented the family Euphorbiaceae (still including Phyllanthaceae) in the Flora of Egypt were variable during the last decades. Linnaeus (1753) recognized 92 species belonging to eight genera (*Andrachne* Linnaeus (1753: 1014), *Phyllanthus* Linnaeus (1753: 981), *Croton* Linnaeus (1753: 1004), *Acalypha* Linnaeus (1753: 1003), *Ricinus* Linnaeus (1753: 1007), *Mercurialis* Linnaeus (1753: 1035), *Jatropha* Linnaeus (1753: 1006) and *Euphorbia* Linnaeus (1753: 450). While Boissier (1867 – 1879) raised the number of species to 144 species since he added the genus *Chrozophora* Jussieu (1824: 27) and excluded three genera namely: *Croton*, *Acalypha* and *Jatropha*. Muschler (1912) re-included the genus *Croton* and reduced the species number to 50 species in seven genera. Furthermore, Täckholm (1956, 1974) ignored the occurrence of *Croton* in Egypt, she reported *Flueggea* Willdenow (1805: 637) for the first time. The most work deals with the family Euphorbiaceae *s.l.* in Egypt was Boulos (2009), in which the family was represented by 55 species in eight genera: *Andrachne*, *Flueggea*, *Phyllanthus*, *Chrozophora*, *Ricinus*, *Mercurialis*, *Jatropha* and *Euphorbia*.

Although the classification system proposed by the Angiosperm Phylogeny Group (APG IV, 2016) recognized Phyllanthaceae as one of five segregates families of Euphorbiaceae *s.l.*, the genera *Andrachne*, *Flueggea*, *Phyllanthus* are still including in Euphorbiaceae in the flora of Egypt. So, the main aspects of this study are: 1- updates the taxonomic status of the genera of Euphorbiaceae and Phyllanthaceae in Egypt. 2- carry out a taxonomic revision of most genera belonging to Phyllanthaceae (as

a new family to Egypt) and Euphorbiaceae to confirm the segregation that proposed by APG system.

A critical taxonomic revisions have been carried out before only on the genus *Euphorbia* by many authors (Fayed *et al.*, 1973; El Hadidi, 1973; El-Karemy, 1994; Fayed and Hassan, 2007). So, the genus *Euphorbia* not included in our study.

Furthermore, this study provides a comprehensive account of all names previously placed in *Andrachne*, *Flueggea*, *Phyllanthus* (Phyllanthaceae) and *Ricinus*, *Mercurialis*, *Jatropha* (Euphorbiaceae) as well as to verify their protologue types, distribution, phenology, and current generic assignments. The most important diagnostic characters for each taxon are illustrated. Furthermore, keys for the genera and species are also included.

## MATERIAL AND METHODS

Morphological data of the most related genera (*Andrachne*, *Flueggea*, *Phyllanthus*, *Ricinus*, *Mercurialis* and *Jatropha*) were collected by examination of herbarium specimens kept in different Egyptian herbaria: ASTU, CAI, CAIM, TANE, CAIRC, Boulos Herbarium (Egypt, Cairo) as well as Helwan University Herbarium (Egypt, Giza, Helwan University); herbarium acronyms following Thiers (2017). In addition, photos of type specimens were seen online by authors and indicated by!.

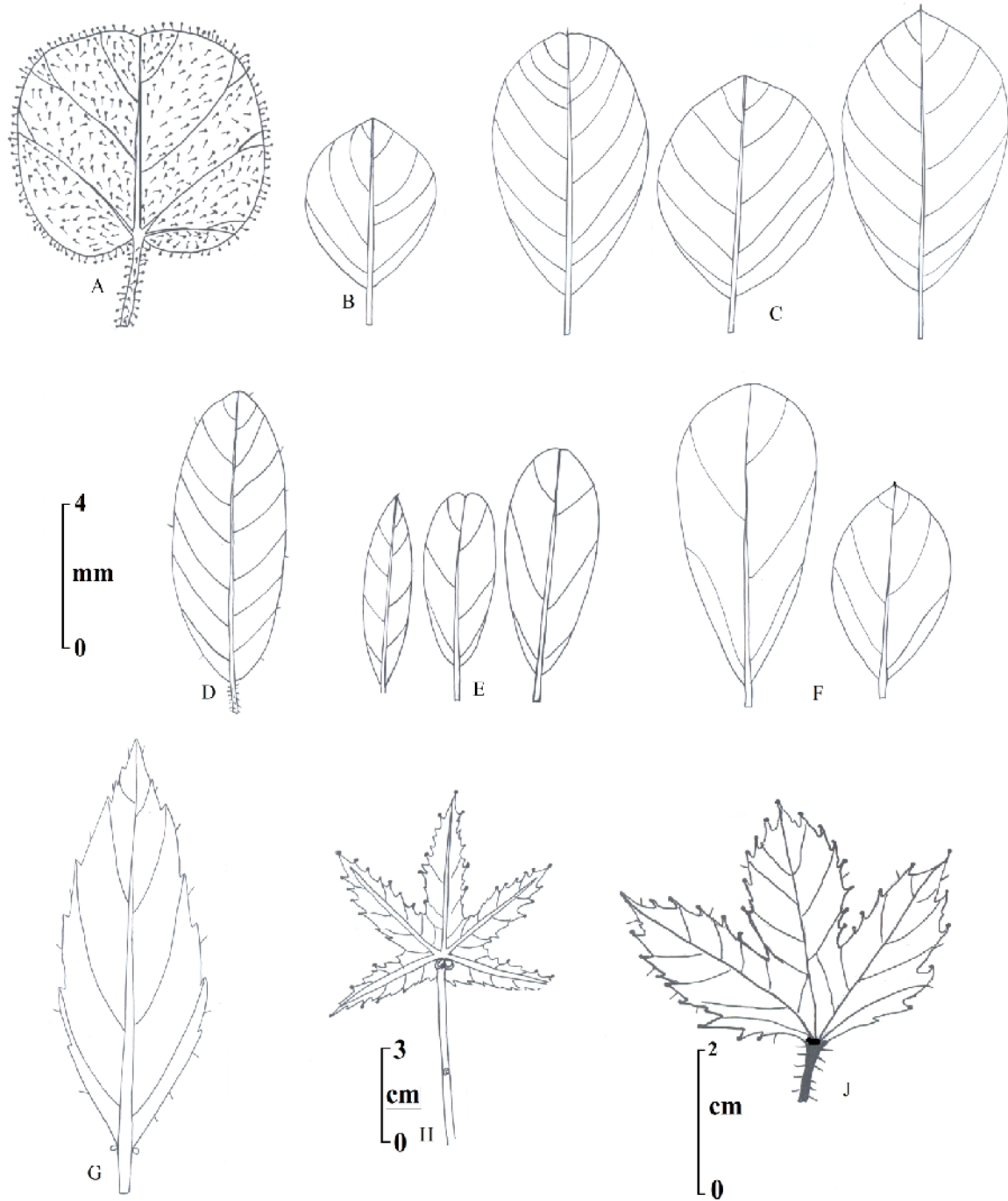
The specimens were examined by Willd 3 Zewz stereomicroscope. Illustrations were made by the authors with a Camera Lucida and photographed by Olympus SZ61 camera located in ASTU Herbarium.

## KEY TO GENERA

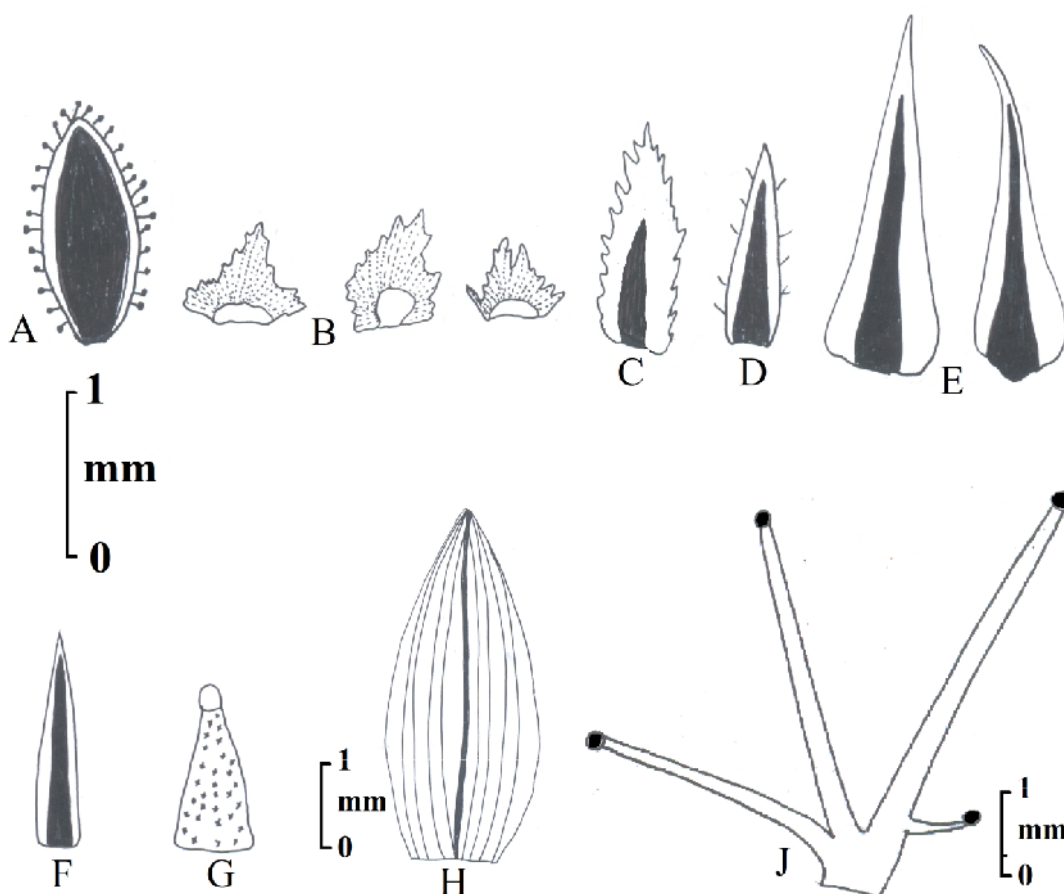
1. Leaves usually simple, margin entire, embedded laminar glands absent; two ovules per locule, seed ecarunculate.....2
- Leaves simple or palmately lobed, margin toothed, embedded laminar glands present; one ovule per locule, seed carunculate .....4
2. Plant dioecious; clearly observed pistillode style-like .....*Flueggea*
- Plant monoecious; pistillode minute or absent.....3
3. Plant prostrate or decumbent, staminate flowers petaliferous, pistillode present.....*Andrachne*
- Plant erect, staminate flowers apetalous, pistillode absent.....*Phyllanthus*
4. Dioecious; herbs; leaves simple, opposite; fruits two locules, pubescent; seed reach 1.5 mm long..... *Mercurialis*
- Monoecious; shrubs or tree-like shrubs; leaves lobed, alternate; fruits 3-locules, echinate or glabrous; seed length excesses 5 mm long .....5

5. Leaves 3–4 lobed, petiole 1–3.5 cm; stipules glandular, branched, filiform in shape; fruits glabrous.....*Jatropha*

- Leaves 5–9 lobed, petiole 5–11 cm; stipules eglandular, unbranched, deltoid in shape; fruits echinate ..... *Ricinus*



**Fig. 1.** Leaves of investigate taxa: **A.** *Andrachne aspera*; **B.** *Andrachne telephioides*; **C.** *Flueggea virosa*; **D.** *Phyllanthus reticulatus* var. *reticulatus*; **E.** *Phyllanthus maderaspatensis*; **F.** *Phyllanthus rotundifolius*; **G.** *Mercurialis annua*; **H.** *Ricinus communis*; **J.** *Jatropha glauca*.



**Fig. 2.** Stipules: **A.** *Andrachne aspera*; **B.** *Andrachne telephioides*; **C.** *Flueggea virosa*; **D.** *Phyllanthus reticulatus* var. *reticulatus*; **E.** *Phyllanthus maderaspatensis*; **F.** *Phyllanthus rotundifolius*; **G.** *Mercurialis annua*; **H.** *Ricinus communis*; **J.** *Jatropha glauca*.

**TAXONOMIC TREATMENT**

**Phyllanthaceae**

**Phyllanthoideae**

**Tribe I. Poranthereae** Grüning (1913: 13)

**1. *Andrachne* L.** (1753: 1014).

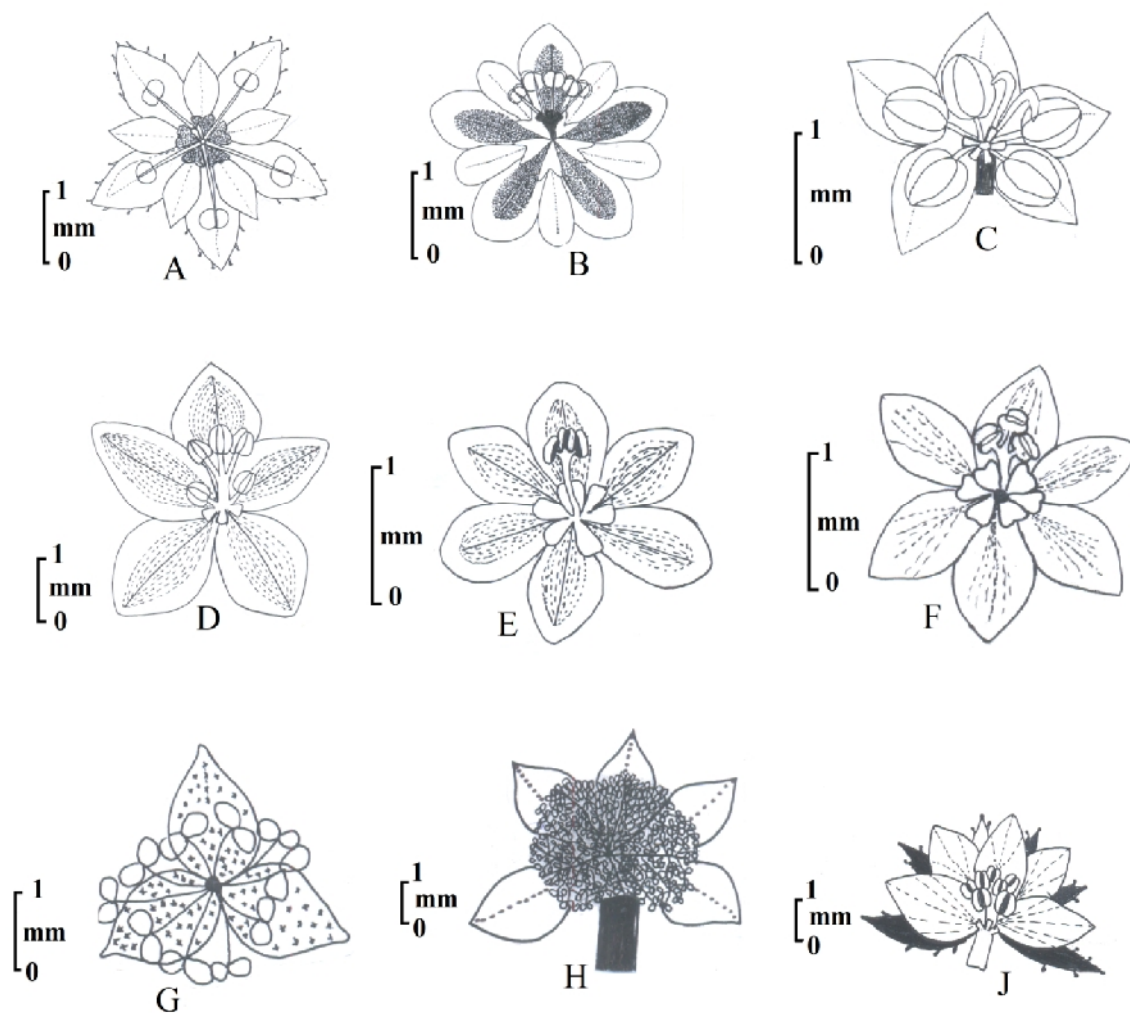
**Type:** *Andrachne telephioides* L. (1753: 1014), lectotype designated by Radcliffe-Smith in Meikle (Ed), flora Cyprus 2 (1985: 1448).

**Taxonomic notes:** The most important sectional treatment of the genus *Andrachne* was carried out by Pax and Hoffmann (1922), in which the genus was divided into 4 sections based on morphological characters of the flowers: sects. *Arachne* (Necker, 1790: 348) Endlicher (1840: 1119), *Telephioides* (Mönch, 1802: 310) Endlicher (1840: 1119), *Fruticulosae* Pax and Hoffmann (1922: 176) and *Phyllanthidea* (Didrichsen, 1857: 150) Müller (1866: 237). The two Egyptian species of *Andrachne*: *A. aspera* Sprengel and *A. telephioides* Linnaeus represented in two sections: *Phyllanthidia* and *Telephioides*, respectively. According to Vorontsova and Hoffmann (2008), the

genus *Andrachne* was divided into two subgenera: *Andrachne* subgenus *Andrachne* which characterized by the absence of indumentums, stipules margin lacinate and glabrous fruit, this subgenus is represented in Egypt by *Andrachne telephioides*. The second subgenus is *Andrachne* subgenus *Phyllanthidea* (Didrichsen 1857: 150) Vorontsova and Hoffmann (2008: 56), which differ from the former subgenus in having simple or glandular unicellular trichomes, stipules margin being entire and the fruits with hirtellose hairs, this subgenus is represented in Egypt by *Andrachne aspera*.

**Key to *Andrachne* species**

1. Plant with glandular unicellular hairs; leaves suborbicular-reniform, petiole 2.5–6 mm long; stipules green, female sepals lanceolate, fruit glandular-hirtellous, seeds yellowish, reticulate-foveolate..... *Andrachne aspera*
- Plant glabrous; leaves elliptic-ovate, petiole 0.5–2 mm long; stipules chaffy, female sepals ovate-rhomboid, fruit glabrous, seed dark brown, pustulate, foveolate .....*Andrachne telephioides*



**Fig. 3.** Staminate flowers: **A.** *Andrachne aspera*; **B.** *Andrachne telephioides*; **C.** *Flueggea virosa*; **D.** *Phyllanthus reticulatus* var. *reticulatus*; **E.** *Phyllanthus maderaspatensis*; **F.** *Phyllanthus rotundifolius*; **G.** *Mercurialis annua*; **H.** *Ricinus communis*; **J.** *Jatropha glauca*.

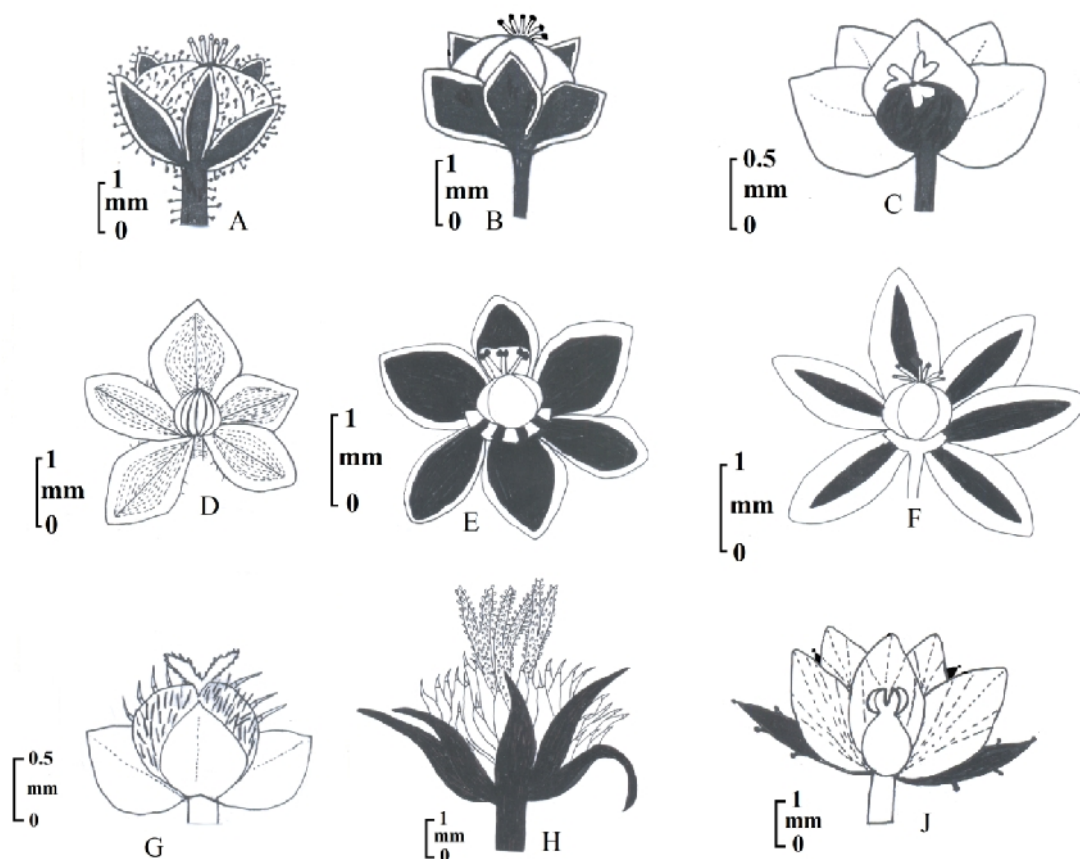
**1. *Andrachne aspera*** Spreng. (1826: 884).

**Type:** Egypt, no collection date, *Lippi* s.n. (holotype: B, isotype G-DC & P).

**Synonym:** *Andrachne aspera* var. *glandulosa* Hoch. ex Rich. (1851: 254), Type: Ethiopia, 9 Nov. 1838, Schimper 1112 (isotype: G00383802!)

**Description:** Monoecious, Prostrate-procumbent or ascending, perennial herb, glaucous, unicellular glandular hairs, 20–25 cm high. Stem arising from a woody base, the inner stem longer than lateral one. Stipules 0.9–1.3 mm length, lanceolate-ovate, green midrib provided with narrow hyaline margin with small red blotch at base, indumentums unicellular glandular hairs. Petiole 2.5–6 mm length, indumentums unicellular glandular hairs. Leaves simple, 1.3–6 × 1.5–7 mm, suborbicular-reniform, retuse to emarginate apex, cordate base, entire margin, 4-basal actinodromous

veins. Flowers solitary. Staminate flowers pedicel 1.5–1.9 mm length; 5-sepals, pale green, 1.5–1.7 × 0.7–0.8 mm, ovate-rhombic with sub-acuminate-obtuse apex; petals whitish, 1–1.2 × 0.4–0.5 mm, ovate-rhombic with acute apex; 5-gland discs, obovate, rugulose, scarcely bifid apex, stacked; 5-stamens, free, 0.9–1.2 mm long, anther two lobes, circular, bright yellow; pistillode minute, 0.2–0.3 mm, 2-lobes, colorless. Pistillate flowers pedicel 2–3 mm long; 5-sepals, valvate, green, 2.3–2.5 × 0.6–0.7 mm, lanceolate with acute apex, dark green at midrib with narrow hyaline margin, indumentums glandular hairs; petals reduced or minute, subulate; 5-separated gland discs, oblong-obovate with red truncate apex; ovary subglobose, 3-carpels, 2-ovules in each cell; 3-styles, 0.5–0.6 mm, bifid to base, erect. Fruits 1.5–1.7 × 3–4 mm diam., rounded to trigonous-subglobose, densely unicellular glandular-hirtellous.



**Fig. 4.** Pistillate flowers: **A.** *Andrachne aspera*; **B.** *Andrachne telephioides*; **C.** *Flueggea virosa*; **D.** *Phyllanthus reticulatus* var. *reticulatus*; **E.** *Phyllanthus maderaspatensis*; **F.** *Phyllanthus rotundifolius*; **G.** *Mercurialis annua*; **H.** *Ricinus communis*; **J.** *Jatropha glauca*.

Seed 1.5 × 1.2 mm diam., triquetrous, yellowish, reticulate-foveolate.

**Distribution in Egypt:** Desert east of the Nile including that of Sinai, Red Sea coastal strip, Gebel Elba and the surrounding mountainous regions.

**Global distribution:** North Africa, Cape Verde Islands, West Asia, Sudan, Cameron, Ethiopia, Socotra and Somalia.

**Representative specimens examined: Egypt.** Red Sea: North Galala, 5 April 1924, *Simbson 2641* (CAIM); South Galala, 5 February 1960, *Täckholm et al. 34* (CAI); Gebel Gharib, 12 May 1983, *Joseph Hobbs 67* (AIRC); Sinai: Gebel Katherine, 20 April 1926, *Khattab & Abdallah 957* (CAIM); Southern Sinai, Wadi Sebaeia, 28° 33' 40.7" N, 33° 59' 40.1" E, 1440 m, 28 January 1999, *Boulos & Amer Ali 1980* (Boulos Herbarium); Gebel Serbal Region, Wadi Aleyaat, 28.66861 N, 33.65377 E; 901 m Alt., 22 April 2004, *Fayed et al. s.n.* (ASTU); St Catherine, Wadi El Arbaein, 28° 32' 56" N 33° 57' 17" E, 22 October 2009, *Fahmy et al. 18* (Helwan herbarium); Gebel Elba: Wadi Almor, 8 October 1926, *Kaiser s.n.* (CAIM); Khor across Gebel El- Shallal, 24 January 1962, *Täckholm et al. s.n.* (CAI).

**Habitat:** Desert wadis and stony hillsides, sea level about 2400 m alt.

**Phenology:** Flowering and fruiting during December-May and may extend to August

**Taxonomic notes:** Boissier (1867 – 1879) recorded *Andrachne aspera* in the flora of Egypt for the first time. *Andrachne aspera* can easily recognize by the presence of obovate gland discs with truncate apex in the pistillate flowers (Fig. 5A) in addition to greenish ovate-lanceolate stipules (Fig. 2A) and glandular hairs on all parts of plant (Figs. 1A, 2A, 3A, 4A, 5A, 6A). The seed being reticulate-foveolate .

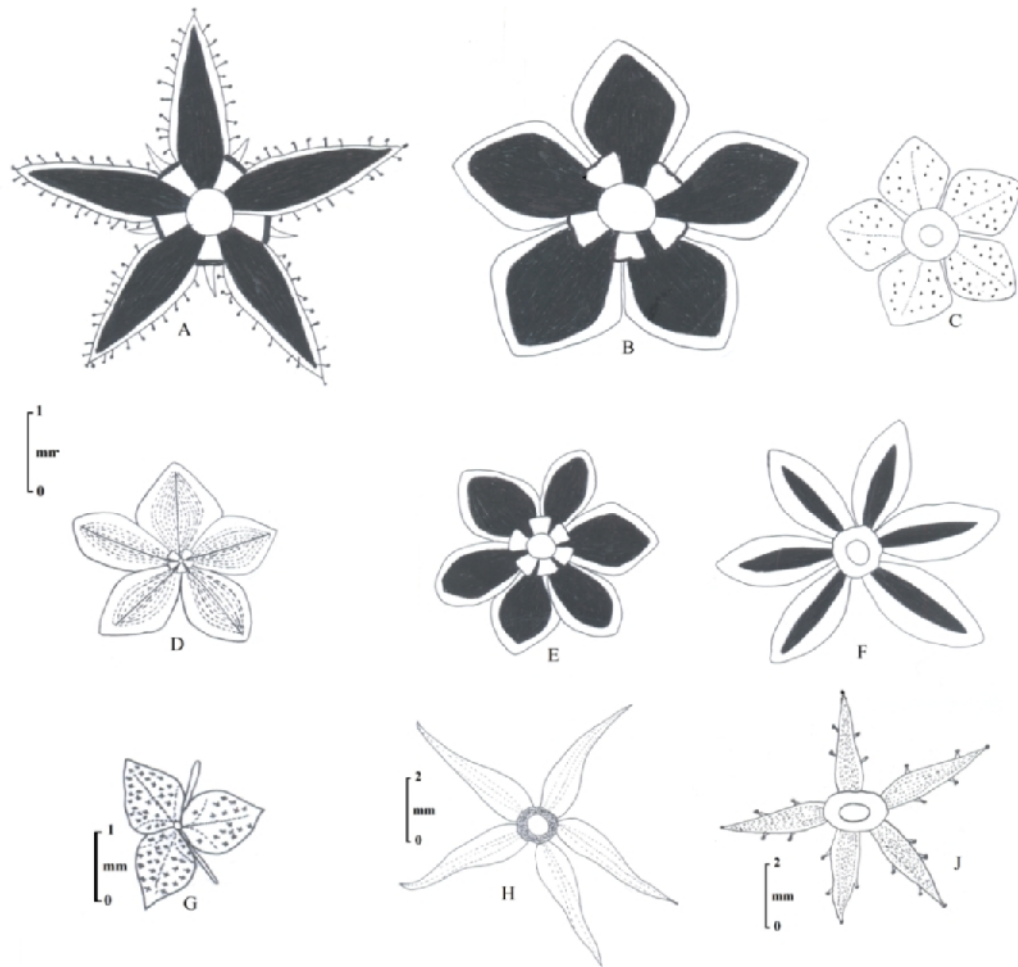
**1.2. *Andrachne telephioides* L.** (1753:1014).

**Lectotype:** designated by Radcliffe-Smith in Meikle (Ed), *Flora Cyprus 2* (1985: 1448); described from several locations: Italy, Greece, Iraq and Turkey, no collection date, *Anon. s.n.* (LINN-1155.1!)

**Synonym:** *Andrachne telephioides* var. *rotundifolia* (Mey.) Müll. (1866: 236);

*Andrachne rotundifolia* Eichw. ex Meyer (1831: 20).

**Description:** Monoecious, Prostrate-ascending, perennial herb, pale green, entirely glabrous, 20–33 cm high. Stem with numerous branching arising from base.



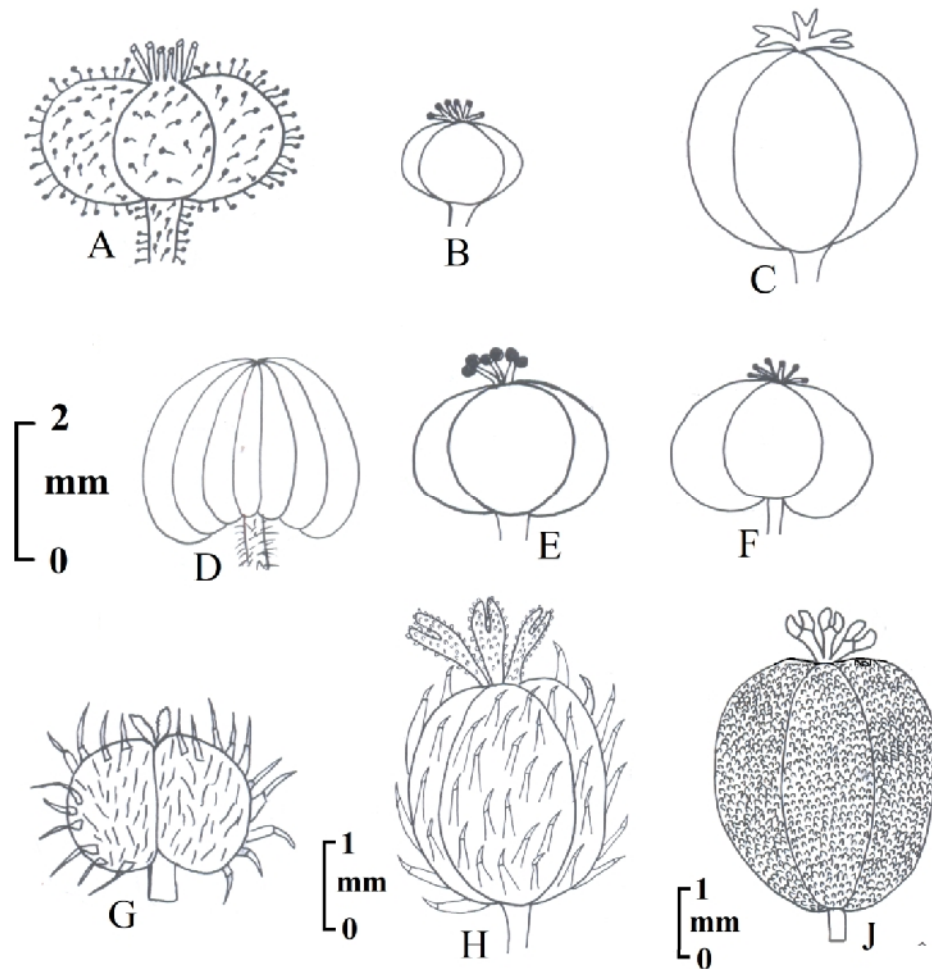
**Fig. 5.** Female calyx: **A.** *Andrachne aspera*; **B.** *Andrachne telephioides*; **C.** *Flueggea virosa*; **D.** *Phyllanthus reticulatus* var. *reticulatus*; **E.** *Phyllanthus maderaspatensis*; **F.** *Phyllanthus rotundifolius*; **G.** *Mercurialis annua*; **H.** *Ricinus communis*; **J.** *Jatropha glauca*.

Stipules, scaly, 0.4–0.8 mm long, ovate, fimbriate, usually with a small or large red blotch at the base, lacerate margin. Petiole 0.5–2 mm long. Leaves simple, 1.9–7 × 2–4.2 mm, elliptic-ovate, subacuminate-obtuse apex, obtuse-round base, entire margin, 3–4 lateral pinnate veins. Inflorescence bisexual, fascicled (1-pistillate flower and 2–3-staminate flowers) or slightly solitary flowers, axillary. Staminate flowers sub-sessile, pedicel 0.8–1 mm long; 5-sepals, green, 1.3–1.5 × 0.7–0.8 mm, ovate-rhombic, provided with greenish midrib and wide hyaline margin, rounded apex; petals whitish, 1.6 × 0.4 mm, oblanceolate with obtuse-truncate apex; 5-gland discs, free, membranous, clearly bifid at apex, reniform, sessile; 5-stamens, 0.7–0.8 mm long, filaments shortly connate at base, anther four lobes, bright-yellow; pistillode, minute, 0.3–0.4 mm

long, three lobes, colorless. pistillate flowers pedicel 2–5 mm length; 5-sepals, greenish, 1.5–2 × 1–1.3 mm, ovate-rhombic, obtuse apex, dark green midrib provided with narrow hyaline margin; petals absent; 5-separated gland discs, membranous, scarcely bifid at apex, slightly square; ovary subglobose, 3-locules, 2-ovules per cell; 3-styles, 0.5–0.6 mm long, bifid to base, slightly ascending to erect. Fruits 1.5–1.8 × 2.5–2.8 mm diam., depressed subglobose, glabrous, distinct reticulate surface. Seed 1.5 × 0.9 mm diam., triquetrous, dark brown-black, foveolate with densely pustulate surface.

**Distribution in Egypt:** Desert east of the Nile including that of Sinai.

**Global distribution:** Mediterranean region, Cape Verde Islands, Somalia, West Asia and Socotra.



**Fig. 6.** Fruits: **A.** *Andrachne aspera*; **B.** *Andrachne telephioides*; **C.** *Flueggea virosa*; **D.** *Phyllanthus reticulatus* var. *reticulatus*; **E.** *Phyllanthus maderaspatensis* **F.** *Phyllanthus rotundifolius*; **G.** *Mercurialis annua*; **H.** *Ricinus communis*, **J.** *Jatropha glauca*.

**Representative specimens examined: Egypt:** Sinai: Wadi El-Arish, 4 April 1939, *Drar s.n.* (CAIM); Wadi Heridin, 15 August: 8 September 1951, *Täckholmet al. 501* (CAI); Gebel El- Halal, 11 November 1988, *El-Hadidi & El-Garfs.n.*(ASTU); Southern Sinai, Bedouin farm, Wadi Rimthi, 28° 37' 53" N, 34° 04' 37.3" E, 1200 m, 27 November 1999, *Boulos & Tamer Ali9163*(Boulos Herbarium); Wadi Atlah , 28° 33' 37" N 33° 56' 33" E, 5 May 2010, *Fahmy et al.174*(Helwan Herbarium).

**Habitat:** Desert wadis, sandy plains and stony ground.

**Phenology:** Flowering and fruiting seasons from March to October.

**Taxonomic notes:** The morphology of flowers usually used as a taxonomical character to differentiate between the taxa of *Andrachne*, either on the level of sections or

species (Müller, 1866, Pax and Hoffmann, 1922, Webster, 1994b). *Andrachne telephioides* is similar to *A. aspera* especially in flowers characters but both species differ mainly in the sepal shape of pistillate and staminate flowers and gland discs of pistillate and staminate flowers. In *A. Aspera* pistillate sepals being lanceolate with acute apex and provided with simple unicellular glandular hairs (Fig. 5A); while in *A. telephioides* it is glabrous ovate-rhombic with obtuse apex (Fig. 5B). The gland discs of pistillate flowers in *A. telephioides* are annular, square, membranous with a scarcely bifid apex (Fig. 5B), whereas in *A. aspera* they are clearly separated, oblong-obovate with red truncate apex (Fig. 5A).



Furthermore, the gland discs of staminate flowers are membranous and clearly furcate in *A. telephioides* (Fig. 3B) and are stacked, obovate rugulose in *A. aspera* (Fig. 3A). Several additional characters may be used to distinguish *A. telephioides*: the seed sculpturing is pustulate, foveolate and the surface of fruits is glabrous (Fig. 6B).

**Tribe II. Phyllanthaceae** Dumort. (1829: 45).

**2. *Flueggea*** Willd. (1805: 637).

**Type:** *Flueggea leucopyrus* Willd. (1805: 757), India: no collection date, *Klein 64, 401, 576* (holotype: B-W 18342-010!, B-W 18342-020!, B-W 18342-030!).

**Taxonomic notes:** On the bases of fleshy fruits and distinct hilum on the seed, Bentham (1880) distinguished *Flueggea* from *Securinega*. The taxonomic interpretation between the two genera was established early due to a misidentification of *Securinega*'s type species (Webster, 1984). Many earliest authors (Hooker, 1887, Pax, 1890, Robinson, 1909, Hutchinson, 1912) used several morphological evidences (pollen grains, ovules types and staminate flowers) to support the generic status between both genera. Based on approximately 24 morphological characters, Webster (1984) divided the genus *Flueggea* into two main sections: sect. *Flueggea* and sect. *Pleioestemon* (Sonder 1850: 135) Webster (1984: 301). Sect. *Flueggea* includes three subsections: *Geblera* (Fisher and Meyer 1835: 28) Webster (1984: 276), *Flueggea* and *Acidothammus* Webster (1984: 299).

**2.1 *Flueggea virosa*** (Will. 1805: 578) Voigt (1845: 152).

**Type:** *Phyllanthus virosa* Willd. (1805: 578).

**2.1.1 *Flueggea virosa*** (Willd.) Voigt **subsp. *virosa***.

**Type:** India, Nandaradah, 23 October 1794, *Klein 748* (holotype: B-W17964 -010!).

**Synonyms:** *Phyllanthus virosa* Willd. (1805: 578); *Securinega abyssinica* A. Rich. (1851: 256); Type: Ethiopia, 4 Jun. 1840, *Schimper 877* (Syntype: L0139138!, L0139139 3!, L0139140!); Ethiopia, 31 Jul. 1840, *Schimper 1698* (Syntype: L0139147!, L0139148!); *Securinega virosa* (Roxb. ex Willd. Baill. (1866: 334); *Flueggea microcarpa* Blume (1825: 580); Lectotype: designated by Barker, C. and Peter C. van Welzen in *Systematic Botany* 35: 584 (2010), Indonesia, Java, no date, *Blumes.n.* (L0828119!).

**Description:** Dioecious, erect, shrubs, entirely glabrous, deciduous, unarmed or spinescent, 2–5 m high. Stem woody at base, reddish-brown with angular branchlets at young, later lenticellate and darker. Stipules 1–1.3 mm long, lanceolate, caducous, lacerate margin. Petiole 2–8 mm long. Leaves simple, 0.6–4.5 × 0.5–3.3 cm, heterophyllous, obovate, elliptic, oblong, obtuse-mucronulate or cleft apex, obtuse-cuneate base, margin entire but after drying become revolute, 5–8 pairs of pinnate veins, greenish above and pale blue-green beneath. Inflorescence unisexual, axillary; staminate inflorescences (clusters in fragrant of 20–30-

flowers per cluster); pistillate inflorescences (solitary or in cluster of 9–10 flowers). Staminate flowers subsessile, pedicel 0.5–1.5 mm long; 5-sepals, imbricate, bright yellow, subequal, 1–1.3 × 0.5–0.6 mm, ovate, acuminate apex, provided with druses crystals; petals absent; 5-gland discs, small, rectangular, interstaminal; 5-stamens long, 0.7 mm long; pistillode large, 0.7–0.8 mm long, style-like with two free branches or appendiculate. Pistillate flowers pedicel 2–4 mm long; 5-sepals, whitish, 1.1–1.2 × 0.9–1 mm, ovate-rhombic, obtuse apex, entire or fimbriate margin provided with druses crystals; petals absent; gland disc, annular, thin; ovary 3-locules, 2-ovules per locule; 3-styles, 0.5 – 1 mm long, 2-fid at apex, connate at base. Fruits 4 mm diam., globose, baccate, indehiscent, whitish, glabrous. Seeds 2.4 × 1 mm diam., triquetrous to ovate, shiny yellowish, with distinct hilar invagination, fine reticulate surface.

**Distribution in Egypt:** Gebel Elba and the surrounding mountainous regions.

**Global distribution:** Australia, Tropical Africa and Asia.

**Representative specimens examined: Egypt:** Gebel Elba: Darawein, 29 January 1933, *Shabetaiz 2512* (CAIM); Wadi Darawein, 29 January. 1933, *Fahmy & Hassib s.n.* (ASTU); Khor across Gebel Shallal, 24 January 1962, *Täckholm et al. 414* (CAI); Wadi Merakwan, 10 February 1962, *Täckholm et al. s.n.* (CAI).

**Habitat:** Rocky ridges.

**Phenology:** Flowering during April to July; fruiting during May to August.

**Taxonomic notes:** *Täckholm* (1956, 1974) described *Flueggea virosa* for the first time to the flora of Egypt as *Securinega virosa*; she has followed Pax and Hoffmann (1931) in using of *Securinega* instead of *Flueggea*. El Hadidi and Fayed (1994/1995) and Boulos (2000) considered *Flueggea virosa* subsp. *virosa* as a valid name for the flora of Egypt. According to Webster (1984), the floral gland disc in pistillate flowers of *Flueggea* appears to be a valuable diagnostic character among the taxa.

*Flueggea virosa* can easily distinguish from the other related members of family Euphorbiaceae by presence of thin annular flat pistillate disk (Fig. 5C) as well as a pistillode with two branches like style (Fig. 3C). On the bases of the morphological characters of fruits and seeds, Webster (1984) included *Flueggea virosa* in sect. *Flueggea* subsect. *Flueggea*. This section characterized by indehiscent (not capsular), baccate fruits and distinct hilar investigated seeds (Fig. 6C).

**3. *Phyllanthus*** L. (1753: 981).

**Type:** *Phyllanthus niruri* L. (1753: 981-982), Lectotype designated by Webster (1956: 13), no collection date, *George Clifford 440, Phyllanthus* (BM 000647367!).

**Taxonomic notes:** The first taxonomic classification of sections in *Phyllanthus* was made by Baillon (1858). Webster, (2002) published the most comprehensive arrangements of sections and subgenera within *Phyllanthus*; he followed the earliest systems of (Müller, 1863, 1866; Pax and Hoffmann, 1931). The branching of *Phyllanthus* ranges from non phyllanthoid branching in which the leaves on the main axis are reduced to hard scale leaves and the secondary branchlets resembles compound pinnate leaves. In Egypt, the genus *Phyllanthus* is represented by four species (Boulos, 2000).

**Key to *Phyllanthus* species in Egypt**

1. Branching non phyllanthoid; leaves spirally arrangement, lanceolate-oblongate; 3-stamens, fused, longitudinally dehiscent .....  
.....*Phyllanthus maderaspatensis*
- Branching phyllanthoid; leaves distichous arrangement, elliptic-suborbicular or elliptic-oblong or obovate..... 2
2. Brachyblasts present; leaves exceeded 2 cm reach to 4 cm; fruits baccate, numerous carpels, violet to blackish.....*Phyllanthus reticulatus*
- Brachyblasts absent; leaves less than 2 cm; fruits capsulate, three carpels, green .....3
3. Herbs; female sepals strongly equal, lanceolate; one gland disc of pistillate flowers, annular; 3-stamens, fused.....*Phyllanthus rotundifolius*
- Shrubs or subshrubs; female sepals subequal, elliptic-ovate or obovate; 5-free gland discs of pistillate flowers; 5-stamens, free.....  
.....*Phyllanthus nummulariifolius*

**3.1. *Phyllanthus reticulatus* Poir. (1804: 298).**

**Type:** Indies, no date, no collector (holotype: P-LA P00381823).

**3.1.1. *Phyllanthus reticulatus* Poir. var. *reticulatus***

**Synonyms:** *Kirganelia multiflora* (Willd.) Baill. var. *glaber* Thwait. (1861: 282); *Phyllanthus multiflorus* Willd. (1805:581).

**Description:** Monoecious, erect, perennial shrubs, 1–2 m high, pubescent. Stem woody, reddish-brown, densely depressed simple multicellular hairs; branches phyllanthoid, brachyblasts.

Cataphylls reddish-brown, 1–1.6 mm long, triangle-lanceolate, longer than leaf stipules. Stipules brownish, 1–1.3 mm long, brownish, subulate-lanceolate, brown at mid rib and wide hyaline margin, indumentums of simple hairs. Petiole 1–3 mm long, densely depressed pubescent of simple hairs. Leaves simple, 8.5–40 × 3.2–18 mm elliptic-oblong, obtuse apex, obtuse-cuneate base, entire margin, 7–8 lateral pinnate veins, chartaceous, dark green adaxially and paler proximally, indumentums sparsely simple hairs. Inflorescence bisexual, fascicles (formed of 3-staminate flowers & 1-pistillate flower), axillary. Staminate flowers pedicel 3–5 mm long, delicate, indumentums depressed simple

hairs; 5-sepals, imbricate, strongly unequal, 1.8–2 × 0.9–1.4 mm, variable in shape, elliptic to obovate, obtuse apex, entire margin, sparsely simple hairs at base; 5-separated gland discs, oblong, toothed at tip; 5-stamens, 3-inner with longer filaments united in a central column, 0.9–1 mm long, 2-outer with shorter filaments, free, 0.3–0.4 mm long; anthers two lobes, triangular, longitudinally dehiscent. Pistillate flowers pedicel 3–7 mm long, delicate, indumentums depressed simple hairs; 5-sepals imbricate, strongly unequal, 1.3–2 × 0.8–1 mm, broadly ovate to oblong, obtuse apex, sparsely simple hairs at base; 5-gland discs, oblong-obovate; ovary subglobose, four to numerous celled, two ovules in each cell; styles numerous, thick, indexed, linear lobes, revolute and conniving over the apex of ovary, very short. Fruits 2–3 × 3–5 mm diam., subglobose, baccate, fleshy, indehiscent, glabrous, black to dark violet. Seed 2 × 1.3 mm diam., brown, trigonous, slightly reticulate surface.

**Distribution in Egypt:** Gebel Elba and the surrounding mountainous regions.

**Global distribution:** Throughout the Old World Tropics.

**Specimen examined: Egypt:** Giza, 22 December 1928, Mohamed Hassib s.n. (CAI).

**Habitat:** Rocky hillsides.

**Phenology:** Flowering and fruiting from August to December (Mathew 1982).

**Taxonomic notes:** Webster & Shaw (1971) included *Phyllanthus reticulatus* in subgenus *Kirganelia* (Jussieu) Webster (1956: 344 and 1957: 51) and sect. *Anisonema* (Jussieu) Grisebach (1859: 34). Webster & Shaw (*op. cit.*) recognized subgenus *Kirganelia* by 4-numerous carpels, baccate fruits (not capsular) and stamens being 5, central 3-fused while the outer 2-free. Our results matching with results of Webster & Shaws results (Fig. 6D, 3D). Täckholm (1956) considered *Phyllanthus reticulatus* as *Phyllanthus discoideus*. While in Täckholm (1974), the name of *Phyllanthus reticulatus* was reported without varieties. Recently, Boulos (2000) divided *Phyllanthus reticulatus* into two varieties. It can easily separated from related taxa by pubescent simple hairs on stem, petiole, flower pedicel, while it is sparsely on leaves and female and male calycis.

**3.2. *Phyllanthus nummulariifolius* Poir. (1804: 302).**

**Type:** Madagascar, April 1851, Boivin, L. H. s.n. (holotype: MNHN-P-P00078248!).

**Synonyms:**

*Menarda nummulariifolia* (Poir.) Baill. (1858: 609), Type: Madagascar, April 1851, Boivin, L.H.s.n. (holotype: P00078248!); *Diasperus nummulariifolius* (Poir.) Kuntze (1891: 600).

**Description:** Monoecious, erect, shrubs-subshrubs, 15–50 cm high, entirely glabrous.

Stem woody; branches phyllanthoid, brachyblasts absent, pinnatifid or bipinnatifid. Cataphylls 1–2 mm long, triangular. Stipules chartaceous, 1–2 mm long, triangular, entire margin. Petiole 0.5–1 mm long, terete. Leaves simple, 5–15 × 4–14 mm, suborbicular-elliptic or obovate, mucronulate or rounded apex, obtuse base, entire margin, membranous or chartaceous, 4–12 lateral pinnate veins. Inflorescences bisexual (1–2 staminate flowers and 1-pistillate flower), axillary. Staminate flowers pedicel 5–6 mm reach to 18 mm long; 5-sepals imbricate, subequal, 1.2–2.1 × 0.9–1.8 mm, suborbicular or obovate, obtuse apex, greenish midrib with wide hyaline margin; 5-gland discs, thin, obovate; 5-stamens, free, 0.5–0.7 mm long, anthers two globose lobes. Pistillate flowers Pedicel 5–20 mm long; 5-sepals imbricate, subequal, 2–2.5 × 1–1.3 mm, elliptic-ovate or obovate, obtuse, greenish midrib with narrow hyaline margin; 5-gland discs, irregularly lobes; ovary globose, 3-carpels, 2-ovules in each carpel; 3-styles, 0.4–0.6 mm long, bifid at apex but fused at the base. Fruits 1–3 mm diam. globose, glabrous. Seed 1 × 0.5 mm diam., trigonous, pale brown, verrucose of tubercles arranged in rows. (Ralimanana & Hoffmann 2011).

**Distribution in Egypt:** The Mediterranean coastal strip.

**Global distribution:** Westwards to Sierra Leone and southwards to S. Africa (Natal), Sudan, Mascarene Island, Madagascar and Seychelles.

**Specimens examined:** No herbarium materials were examined by authors. The only Egyptian specimen was collected by Malak Rezks.n. in 1999 from the Botanic Garden of Alexandria University and located in K herbarium (Boulos, 2000).

**Habitat:** Garden weeds.

**Phenology:** No data available.

**Taxonomic notes:** According to Boulos (2000), this species is naturalized as a garden weed in Egypt. Boulos (*op. cit.*) recorded it for the first time to the flora of the country based on the only herbarium material mentioned above.

### 3.3. *Phyllanthus maderaspatensis* L. (1753: 982).

**Neotype:** proposed by Radcliffe-Smith in Kew Bulletin 40: 685 (1985), India, Madras, Herb. *Heyne* Wall., Num. List No. 7906Fa (K-W).

**Synonym:** *Phyllanthus maderaspatensis* L. var. *maderaspatensis*.

**Description:** Monoecious, erect to ascending, perennial herb, entirely glabrous, 25–30 cm high. Stem woody, branches non phyllanthoid, branching from the base. Cataphylls absent. Stipules 1.8–2 mm long, triangular-lanceolate, yellow-brown with wide hyaline margin, peltate or cordate base. Petiole 1–1.3 mm long. Leaves simple, 4.5–20 × 1.7–5 mm, lanceolate-oblong, retuse-truncate or rounded-mucronate, cuneate base, entire margin, thinly chartaceous. Inflorescence bisexual, fascicled at distal branches (2–4 staminate flowers and 1-pistillate flower), solitary of pistillate

flowers only at proximal branches. Staminate flowers pedicel 0.8–1 mm long; 6-sepals imbricate in two whorls, subunequal, 3-elliptic-obovate with obtuse apex, 3-obovate with acuminate apex, 0.9–1.3 × 0.5–0.6 mm, yellow midrib provided with wide hyaline margin; 6-separated gland discs, oblong; 3-stamens, filaments united in column, 0.7–0.9 mm long, sessile anther, anther two elongated lobes, longitudinally dehiscent. Pistillate flowers subsessile, pedicel 1.5–2 mm long; 6-sepals, imbricate in two whorls, strongly unequal, 1–1.5 × 0.6–1 mm, 3-oblong with obtuse apex and 3-ovate-rhombic with acuminate apex, olive-green midrib with a narrow hyaline margin; 6-gland discs, membranous free, square, thin, flat; ovary rounded, 3-locules, 2-ovules in each cell, smooth; 3-styles, bind not bifid, red capitate stigma. Fruits 1.9–2.2 × 2.8–3 mm diam., rounded, smooth. Seed 1.2 × 0.5 mm diam., triquetrous, brownish, small shiny black tubercles arranged in rows on dorsal and ventral sides.

**Distribution in Egypt:** Gebel Elba and the surrounding mountainous regions.

**Global distribution:** Tropical Africa, Sri Lanka, Arabia, India, Java. China and Australia.

**Representative specimens examined:** **Egypt:** Gebel Elba: 23:27 January 1929, *Gunaar Täckholm s.n.* (CAI); Wadi Kansisrob, 28 January 1933, *Shabetai z2513* (CAIM) & Gebel Karam, 7 February 1962, *Täckholm et al. s.n.* (CAI); Gebel Asotriba, 28 January 1962, *Täckholm et al. 1016* (CAI).

**Habitat:** Stony wadis.

**Phenology:** Fruiting and flowering during January–May.

**Taxonomic notes:** *Phyllanthus maderaspatensis* was recorded for the first time to the Egyptian flora by Linnaeus (1753). Boissier (1867-1879) as well as Muschler (1912) ignored the occurrence of this species in Egypt. While Täckholm (1956) considered it again to the flora of the country. Although *P. maderaspatensis* and *P. rotundifolius* share some morphological characters such as leaf long (up to 2 cm), 3-stamens and 6-sepals, it is seeming that, *P. maderaspatensis* can easily be recognized by some morphological characters, e.g. lanceolate-oblong leaves (Fig. 1E), unequal female sepals (Fig. 5E), bind style with capitate stigma (Fig. 4E) and shiny black seeds with tubercles surface.

Our results are adopted with Webster (1956) and Ralimanana & Hoffmann (2011) in which *P. maderaspatensis* is included in subgenus *Isocladus* Webster (1956: 345) and section *Paraphyllanthus* Müller (1863: 3), which are characterized by a spirally arranged leaves, absence of phyllanthoid branches, 3-stamens and longitudinally dehiscence anther (Fig. 3E).

### 3.4. *Phyllanthus rotundifolius* Willd. (1805: 584).

**Type:** India, grassy plains, no collection date, *Klein* 17984. (holotype: B-W 17984-010!).

**Synonym:** *Phyllanthus rotundifolius* Willd. var. *rotundifolius*.

**Description:** Monoecious, erect, annual herb, 10–30 cm, entirely glabrous. Stem branching from the base, provided with thick waxes forming papillate appendages; branches phyllanthoid, brachyblasts absent, pinnatifid. Cataphylls scarious, 1–1.2 mm long, linear-lanceolate, longer and broader than leaf stipules. Stipules 1.2–1.3 mm long, linear, narrow. Petiole 1–1.2 mm, glabrous. Leaves simple, 5.2–10 × 3.4–5 mm, obovate or suborbicular, obtuse-subacute apex and cuneate base, membranous margin, glaucous or grey-green. Inflorescence bisexual, fascicled (2–3 staminate flowers & 1-pistillate flower), axillary. Staminate flowers pedicel 1–1.4 mm long; 6-sepals, yellow, slightly subequal, 0.8–1.2 × 0.5–0.6 mm, ovate, midrib visible; 6-gland discs, free, thick, obovate, emarginated apex, red; 3-stamens, filaments united into a short column, 0.3–0.5 mm long, bright yellow, anther sessile, two circular lobes, transversely dehiscent. Pistillate flowers pedicel 1–2 mm long; 6-sepals, greenish, strongly equal, 1.5–2 × 0.7–0.8 mm, lanceolate, midrib olive green with wide hyaline margin; one gland disc, annular with irregular crenate margin, red, thick; ovary, globose, 3-locules, 2-ovules in each cell; 3-styles, 0.3–0.4 mm length, bipartite, longitudinally bifid to base. Fruits 1–1.7 × 1.7–2 mm diam., globose, glabrous, olivaceous. Seeds 1.2 × 0.5 mm diam., trigonous, dark brown, ridged striate surface.

**Distribution in Egypt:** The Mediterranean coastal strip, Nile region including the delta, valley and Fayium, Desert east of the Nile including that of Sinai, Red sea.

**Global distribution:** Arabia, Africa, India, Socotra, Sri Lanka and Pakistan.

**Representative specimens examined: Egypt:** Gebel Elba: 18: 25 January 1930, *Hassib s.n.* (CAI); Wadi Ekwâl, 26 Jan. 1933, *Shabetai z2515* (CAIM); Wadi Ideib, 20 January 1962, *Täckholm et al.* 29 (CAI); Slopes of El Kossira mountain of Gebel Elba, 8 February 1962, *Täckholm et al.* 882 (CAI).

**Habitat:** Alluvial and Sandy soils.

**Taxonomic notes:** *Phyllanthus rotundifolius* was mentioned as a new record to the flora of Egypt by Boissier (1867–1879). The most important characters used to distinguish *P. rotundifolius* are: obovate-suborbicular leaves which arranged distichously with width not access 5 mm, stamens transversely dehiscent and apex of male gland discs scarcely bifid (Fig. 3F) as well as the annular gland disc of pistillate flowers (Fig. 5F). According to Müller (1863) and Ralimanana and Hoffmann (2011), *P. rotundifolius* was placed in subgenus *Phyllanthus*, section *Phyllanthus* and subsection *Swartziani* Webster (1955: 53) that distinguish by 3-stamens with connate filaments, transversely dehiscent stamens (Fig. 3F), bifid style (Fig. 4F), and striate seed surface.

**Family II. Euphorbiaceae** Juss. (1789: 384).

**Subfamily I. Acalyphoideae** Ascherson (1864: 58).

**Tribe I. Acalyphaeae** Dumort. (1829: 45).

**Subtribe I. Riciniinae** Griseb. (1859: 37).

*Ricinus* L. (1753:1007).

**Lectotype:** *Ricinus communis* L. (1753: 1007).

**4.1. *Ricinus communis*** L. (1753: 1007).

**Lectotype:** designated by *Seeger*, in Oil Pl. Ethiopia : 212 (1982), Africa, India and Southern Europe Herb., no collection date, *George Clifford* 450 (BM000647441!).

**Synonyms:** *Ricinus africanus* Mill. (1768: 5).

**Description:** Monoecious, erect, annual or perennial herb tree-like, entirely glabrous, glaucous, 50–80 cm high. Stem hollow, branched densely from base, woody at the base, circular. Stipules sheathed, 4–5 mm long, deltoid, opposite to leaf, lateral veins longitudinal parallel to mid vein. Petiole 5–15 cm long, acropetal glands, equalling or exceeding the length of leaf blade. Leaves lobed, palmately 5–9 lobed, 60–70 × 40–50 mm, median lobe usually 6.2–50 × 1.2–10 mm, the lateral lobes smaller 3.2–25 × 1–8 mm, lanceolate, acute apex, cuneate base, coarsely glandular-serrate tooth, lateral nerves reach 8–11 pairs, extend to the margins, two red subsessile large glands at the insertion of petiole, provided also with stipitate, sessile glands on abaxial surface. Inflorescence bisexual, paniculate, racemes (pistillate flowers above and staminate flowers beneath), terminal, peduncle 8–11 cm long. Staminate flowers pedicels 7–10 mm long; 5-sepal, green, 4–7 × 0.9–1.3 mm, ovate-lanceolate, acute apex, glabrous; corolla absent; gland disc absent; stamens numerous, densely branched

filaments connate in clusters, filament long 1.9–2 mm. Pistillate flowers pedicels 3–5 mm long, reach to 2 cm in fruiting; 5-sepals, glaucous green, 4–7 × 0.8–1 mm, lanceolate, caducous, acute apex; one gland disc, annular; ovary oblong, 3-cells, one ovule in each cell; 3-styles, 3–8 mm length, bifid at apex, connate at half, densely papillae above. Fruits 2–12 × 2.5–10 mm diam., oblong, echinate, covered with sparsely bristle-tipped echinate reach to 3–5 mm. Seed 6 × 4.5 mm diam., oblong, brown with shiny grayish, smooth, carunculate; caruncle triangular, hard.

**Distribution in Egypt:** Desert east of the Nile except that of Sinai, Gebel Elba and the surrounding mountainous region. Spontaneous in Southeast Egypt, escaped from cultivation and naturalized in all other regions of Egypt.

**Global distribution:** Northeast tropical Africa. Widely cultivated and becoming naturalized throughout subtropical, tropical temperate regions.

**Representative specimens examined: Egypt:** Gebel Elba: North-West and West slopes of Gebel Asotriba, 23 January. 1962, *Täckholm et al.* 1031 (CAI); between Bir Nisht and Wadi Mitikwân of Wadi Allaqi in sand between hills, 400–500 m Alt., 13 February 1963, *Abdallah et al.* 1077 (CAIM); Wadi Diib, 60–70 km, East of Gebel Elba, 30 January 1979, *Boulos 12855* (CAIRC).

**Habitat:** Sandy soil, wadis and plains.

**Phenology:** Flowering and fruiting all most seasons.

**Taxonomic notes:** According to Boulos (2000), *R. communis* is spontaneous in Southeast Egypt, escaped from cultivation and became naturalized in all phytogeographical zones of the country. *R. communis* is mainly differing from all related taxa in terms of leaves, petiole, staminate flowers as well as fruits surface ornamentation (Webster, 1967). Leaves are palmately 5–9 lobed (Fig. 1H), petiole long 5–15 cm, covered by acropetiolar glands (Fig. 1H, 8F), numerous stamens of staminate flowers (Fig. 3H), and the fruits are covered with sparsely bristle tipped appendages (Fig. 6H).

**Subtribe II. Mercurialinae** Pax (1890: 46).

**5. Mercurialis** L. (1753: 1035).

**Type:** *Mercurialis perennis* Linnaeus (1753: 1035), Lectotype designated by Radcliffe-Smith in Jarvis & al. (Ed.), *Regnum Veg.* 127: 66 (1993):— Netherlands, Herb. Clifford, *Mercurialis* No. 1 461 (BM000647504!).

**5.1. Mercurialis annua** L. (1753: 1035).

**Type:** Lectotype, designated by Radcliff-Smith in Meikle (ed.), *Flora Cyprus* 2: 1451(1985), *Europae*, no date, Herb. *Linnaeus 1188.3* (LINN 1188.3).

**Synonym:** *Synema annuum* (L.) Dulac (1867: 154).

**Description:** Dioecious, erect-ascending, annual herb, almost glabrous, 20–40 cm high. Stem densely branching from base, glabrous, armed. Stipules colorless, 1–1.2 mm long, deltoid, apex with gland tipped provided with druses crystals. Petiole 1–2.5 mm long, glabrous. Leaves simple, 11.5–70 × 3.9–28 mm, ovate-lanceolate, opposite, serrate margin, acuminate or subacute apex, cuneate base, dentate margin, indumentums of sparsely simple unicellular hairs on margin, two stalked glands at petiole insertion.

Inflorescence unisexual, sub-axillary; staminate inflorescence spike racemes, peduncle 4–8 cm long that divided to several parts, fertile part 2–4 cm beneath, followed by 7–15 clusters of staminate flowers (6–10 flowers in each clusters), internodes between clusters reach 0.5–1 cm decrease towards the apex; pistillate flowers are 3–4 flowers in clusters.

Staminate flowers subsessile, pedicel 0.5–0.7 mm length; 3-sepals, colorless, 1.5–2 × 0.9–1.2 mm, ovate, apiculate to mucronate apex, glabrous, provided with little druses crystals; petals reduced; gland disc absent; stamens 8–18, free, 1–1.5 mm long, subglobose anther, whitish, transversely dehiscent. Pistillate flowers subsessile, pedicel 1–2 mm long; 3-sepals, whitish, 1–1.2 × 0.9–1 mm, ovate, partially fused, glabrous provided with druses crystals; petals reduced; 2-gland, filiform, 0.5–0.6 mm long; ovary 2-locules, 1-ovule per locule; 2-styles free or scarcely fused at the base, strongly papillose. Fruits 1.8–2.5 × 2.6–4.5 mm diam., subglobose, covered with bulbous-based hairs on valvate sides and tubercles-based hairs on dorsal sides, greenish. Seeds 1.8 × 1.2 mm, ovoid, grey or brown, pitted, carunculate.

**Distribution in Egypt:** The Nile region including the delta, valley and Fayium, the entire Sinai Peninsula including the coastal Mediterranean strip and El-Tih Desert east of Suez Canal.

**General distribution:** Europe, North Africa, Macaronesia, East Mediterranean region, Iraq and Arabia.

**Representative specimens examined: Egypt:** Nile valley region: Giza, 28 Aug. 1922, *Simpson1551* (CAIM); El Rahawy village, 18 March 1999. *D. A. Ahmed* and *H.A. Hossni81*(TANE); Alexandria, Samouha cultivations behind Nuzha gardens, 23 March 1956, *V. Täckholm & El-Hadidis.n.*(CAI, ASTU); MersaMatruh, Wadi Halazeen, 45 km west, 25 April 1996, *El-Garf s.n.*(CAIRC).

**Habitat:** Roadsides and waste grounds.

**Phenology:** Flowering and fruiting during February–November.

**Taxonomic notes:** Linnaeus (1753) mentioned *Mercurialis annua* for the first time to the flora of Egypt. In agreement with Webster (1967), it would seem that *Mercurialis annua* can be easily separated from all the studied taxa by several morphological characters, e.g. opposite leaves that covered with simple hairs on serrate margins (Fig. 1G); ovary with two locules (Fig. 6G); unlobed style (Fig. 4G) as well as pistillate flowers provided with two filiform glands (Fig. 5G).

**Subfamily II. Crotonoideae** Pax (1884: 413).

**Tribe I. Jatrophae** Pax (1890: 72).

**6. Jatropha** L. (1753:1006).

**Type:** *Jatropha gossypifolia* L. (1753: 1006). *Anon. s.n.* (LINN-1141.1!), Conserved type, designated by Wijnands (1983: 104).

**6.1. Jatropha glauca** Vahl (1790: 78).

**Type:** Yemen, 1763, *Forsskål, P.1370* (holotype: C10002440!, isotype: BM000951494!).

**Synonyms:** *Croton labatum* Forssk. (1775: 162), non Linnaeus (1753); *Jatropha lobata* (Forssk.) Müll. (1866: 1085), nom. illeg.

**Description:** Monoecious, erect, low shrubs, 20–40 cm. Stem branched from base, woody, almost glabrous. Stipulate filiform, 5–9 mm long, branched, apex with gland tipped. Petiole 2–3.5 cm long, indumentums simple unicellular hairs. Leaves lobed, palmately 3-lobed, 4.5–6 × 4–6 cm, alternate, bright green, margin dentate, tooth ended with gland tipped, base cuneate, lobes with acute apex, indumentums of sparsely simple unicellular hairs. Inflorescences bisexual, terminal, dichotomous cymose usually with single pistillate flower terminating each major axis and two lateral staminate flowers, main peduncle 6 cm long, lateral peduncle 2.5–3 cm long; bracts entire or glandular-fimbriate, 6 mm. Staminate flowers pedicel 8 mm long, 5-sepals, imbricate, 2–3 × 0.5–0.6 mm, lanceolate, tipped glands margin; 5-petals, imbricate, yellow, 2.5–3 × 0.9–1 mm, ovate-lanceolate, nerved; 7–10-stamens in 2 whorls, filaments partially fused.

Pistillate flowers pedicel 2–3 mm long, sepals and petals similar to staminate flowers; one gland disc, annular, thick, red; ovary 3-celled, one ovule per cell; 3-styles, 0.5–0.7 mm long, bifid at apex and connate at above half, red. Fruits 0.9–1.1 × 0.7–0.9 cm diam., oblong, rugulose surface, yellow-brown. Seeds 8 × 5 mm diam., oblong, shiny brown, smooth, carunculate; caruncle much divided to 9–10-lobes, red.

**Distribution in Egypt:** Gebel Elba and the surrounding mountainous region.

**Global distribution:** Saudi Arabia, Djibouti, Sudan, Ethiopia, Eritrea, Arabia, Yemen and Somalia.

**Specimen examined:** No Egyptian material was seen by the authors. The only examined specimen was collected by *M. Drar* in 4 Feb.1938 from Sudan and located in CAI herbaria.

**Habitat:** Rocky ground.

**Phenology:** No data available.

**Taxonomic notes:** Täckholm (1956) was reported *Jatropha glauca* as a new record to the flora of Egypt. This species may be similar to *Ricinus* by having lobed leaves but it differs in number of lobes, being 3-lobes in *Jatropha glauca* (Fig. 1J), presence of sparsely simple short hairs on leaves margin. In addition, presence of dissected caruncle in seeds of *Jatropha* while in *Ricinus* isentire but differs mainly in having filliform glandular stipules (Fig. 2J), limited number of stamens being 7–10-stamens (Fig. 3J) and rugulose glabrous fruits (Fig. 6J). Presence of petals in staminate and in pistillate flowers are distinguished for this taxon (Fig. 3J, 4J).

## DISCUSSION

The segregation of Euphorbiaceae *s.l.* into distinct families was maintained by Angiosperm Phylogeny Group (APG IV, 2016) based on molecular and morphological data. Although the Euphorbiaceae *s.l.* have been studied by several authors on the levels of molecular systematics, taxonomy, phytochemistry and anatomy, the information of this family still has considerable gaps regarding morphological studies (Secco *et al.*, 2012).

The family was divided into five families: Phyllanthaceae, Putranjivaceae, Picrodendraceae which exhibits two ovules in each locule and Pandaceae, Euphorbiaceae *s.s.* which has one ovule per locule (Secco *et al.*, 2012, Judd *et al.*, 2009).

Regionally, the taxonomy of family family Euphorbiaceae did not get enough attention in Egypt. According to the recent classification system of Angiosperm Phylogeny Group (APG IV, 2016),

Euphorbiaceae is representing in Egypt by only two families: Phyllanthaceae, comprising the subfamily Phyllanthoideae and Euphorbiaceae *s.s.*, Acalyphoideae and Crotonoideae.

Subfamily Phyllanthoideae represents in Egypt by three genera, namely *Andrachne*, *Flueggea* and *Phyllanthus*. Phyllanthoideae can easily distinguish from other subfamilies by the presence of two seeds in each locule, while in the rest subfamilies it being only one seed in each locule (Secco *et al.*, 2012, Webster, 1975, 1994 b). According to Webster (1994 b), Phyllanthoideae is represented by only one tribe namely Phyllantheae which includes two subtribes: Andrachninae (Müller 1865: 64) and Flueggeinae (Müller 1865: 64), while in APG IV (2016) it represented by two tribes Poranthereae and Phyllantheae without any subtribes (Table 1). Both tribes can recognize by the presence or absence staminate petals, they are five in tribe Poranthereae (as shown in the genus *Andrachne*, Fig. 3A, 3B) while being absent in tribe Phyllantheae (as shown in *Phyllanthus*, Figs. 3D, 3E, 3F and *Flueggea*, Fig. 3C).

Both genera: *Flueggea* and *Phyllanthus* which included in tribe Phyllantheae are some morphological characters such as lacking staminate petals (Fig. 3C and Fig. 3D, 3E, 3F). On the other hand, the genus *Flueggea* differ mainly from the genus *Phyllanthus* by being dioecious and having pistillode in its staminate flowers (Fig. 3C).

Furthermore, subfamily Acalyphoideae represents by two genera: *Ricinus* and *Mercurialis*. The genus *Jatropha* considered as the only genus which included in the subfamily Crotonoideae. In spite of the two subfamilies: Acalyphoideae and Crotonoideae share some morphological characters such as solitary ovule in each locule and absence of pistillode, it seems that subfamily Acalyphoideae differ mainly in present of foliar glands on their leaves surface (Webster, 1994 b). Subfamily Acalyphoideae considered by only one tribe namely Acalyphae which includes two subtribes: Ricininae and Mercurialinae. According to Webster (1967, 1994 b) and APG IV (2016), there are taxonomic variations between both subtribes. All members of subtribe Mercurialinae are dioecious, having simple indumentums, with opposite leaves, two staked glands at petiole insertion of leaves, sub-axillary inflorescences, unlobed style and 2-filliform pistillate disk (as characterized in the genus *Mercurialis*, (Fig. 5G).

**Table 1: Synopsis of the studied taxa according to Webster (1994b) and APG (2016).**

Genera	Webster 1994b				APG IV 2016			
	Family	Subfamily	Tribes	Subtribes	Family	Subfamily	Tribes	Subtribes
<i>Andrachne</i>	Euphorbiaceae <i>s.l.</i>	Phyllanthoideae	Phyllantheae	Andrachnina	Phyllanthaceae	Phyllanthoideae	Poranthereae	-
<i>Flueggea</i>	Euphorbiaceae <i>s.l.</i>	Phyllanthoideae	Phyllantheae	Flueggeinae	Phyllanthaceae	Phyllanthoideae	Phyllantheae	-
<i>Phyllanthus</i>	Euphorbiaceae <i>s.l.</i>	Phyllanthoideae	Phyllantheae	Flueggeinae	Phyllanthaceae	Phyllanthoideae	Phyllantheae	-
<i>Ricinus</i>	Euphorbiaceae <i>s.l.</i>	Acalyphoideae	Acalyphae	Ricininae	Euphorbiaceae <i>s.s.</i>	Acalyphoideae	Acalyphae	Ricininae
<i>Mercurialis</i>	Euphorbiaceae <i>s.l.</i>	Acalyphoideae	Acalyphae	Mercurialinae	Euphorbiaceae <i>s.s.</i>	Acalyphoideae	Acalyphae	Mercurialinae
<i>Jatropha</i>	Euphorbiaceae <i>s.l.</i>	Crotonoideae	Jatropheae	-	Euphorbiaceae <i>s.s.</i>	Crotonoideae	Jatropheae	-

While subtribe Riciniinae, in which the genus *Ricinus* included, is characterized by being monoecious, indumentums absent, leaves alternate, inflorescences terminal, style bifid and the pistillate disk being annular (Fig. 4H, 5H). It is notable that in subfamily Crotonoideae, in contrast with other subfamilies, is characterized by having dichasial cymose inflorescences, petals present on both staminate and pistillate flowers and the stipules being persistent and branched filiform with glandular tipped (Webster, 1994a). These morphological characters matching with our results for the genus *Jatropha* (Fig. 2J, 3J, 4J).

The six genera under investigation that were previously belonged to Euphorbiaceae *s.l.* (*Andrachne*, *Flueggea*, *Phyllanthus*, *Ricinus*, *Mercurialis* and *Jatropha*) can easily separate into two main groups based on morphological characters of seed morphology, number of seeds in each locule and absence or presence of laminar glands on leaf surface. The first group that exhibits ecarunculate seeds, two ovule per locule, absent of glands on leaf comprising *Andrachne*, *Flueggea* and *Phyllanthus* are including in Phyllanthaceae. The second group characterized by carunculate seeds, one ovules per locule, presence of glands on leaf represented by *Ricinus*, *Mercurialis* and *Jatropha* and placed in Euphorbiaceae.

## CONCLUSION

In general view, this study reveals that family Euphorbiaceae *s.l.* in Egypt should segregates into two distinct families: Euphorbiaceae *s.s.* and Phyllanthaceae, in which the later consider as a new family to the flora of Egypt.

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