



New records in the alien flora of Libya: *Euphorbia glyptosperma* Engelm (Euphorbiaceae)

Nuwarah Mohammed Bahri¹, Khaleefah Salem Imohammed¹, Sh-Hoob Mahammed El-Ahamir^{2*}

¹Botany Department, Faculty of Science, Sabha University, Libya

²Botany Department, Faculty of Science, Gharyan University, Gharyan, Libya

*Email: Shhoob.Elhamir@gu.edu.ly

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Abstract

Euphorbia glyptosperma Engelm is recorded for the first time as part of the flora of Libya. This widespread wild weed was collected during 2023–2024 from various locations, including regions in Sabha and Ariggiba (approximately 110 km southwest of Sabha city). To aid in its identification and facilitate future studies, a comprehensive description of the species, habitat information, a distribution map, and distribution data are provided. Additionally, a brief discussion highlights the most significant threats associated with this species.

Keywords: Identification key, Ariggiba Region, Field work, Sabha taxonomy, Alena

Introduction

The family *Euphorbiaceae* is a large and diverse plant family, comprising around 300 genera and nearly 7,000 species distributed in tropical and temperate regions worldwide (Pahlevani & Akhane, 2011; Berry et al., 2016). This family is of considerable economic importance, including rubber and oil-yielding plants, ornamental species, and those with medicinal properties. In Libya, the Euphorbiaceae are represented by 5 genera and 32 species (Jafri & EL-Gadi, 1982). *Euphorbia* L. is one of the most species-rich genera within the Euphorbiaceae, with approximately 2,000 species found globally, particularly in the tropical and subtropical regions (Al-Shaari & Makhoulouf, 2023).

The genus is characterized by a distinctive cyathium inflorescence and the presence of milky latex, and exhibits a diverse array of life forms, including geophytes, herbs, shrubs, trees, succulents, and xerophytic forms (Hornet et al., 2014; Prenner & Rudall, 2007; Swamy & Prasad, 2022; Scafidi et al., 2016). *Euphorbia glyptosperma* is a species of spurge native to North America, with a distribution spanning across much of the continent (USDA, 2023). Commonly known as ridge-seeded spurge. Beyond its native range in North America, *E. glyptosperma* has been reported to have naturalized in other parts of the world, including North Africa, such as in Tunisia, where it has been recorded as a naturalized weed since the 1990s (Chaieb & Boukhris, 1998). The introduction and subsequent naturalization of *E. glyptosperma* in North Africa are believed to have occurred through human-mediated dispersal, such as through the transportation of agricultural products, contaminated seed shipments, or the use of the plant as an ornamental. Once introduced, the species has been able to establish self-sustaining populations in the region, taking advantage of the suitable climatic conditions and available ecological niches. On the basis of literature and herbaria studies, it was referred to *E. glyptosperma* Engelm., an alien species not previously reported from Libya (Jafri & El-Gadi, 1982; Al-Shaari & Makhlouf, 2023; Makhlouf, 2023). In this paper, a new record of *Euphorbia glyptosperma* will be added to the flora of Libya, which will contribute to the understanding of the diversity and distribution of the genus *Euphorbia* in the country.

Material and methods

Specimens of *E. glyptosperma* were found, photographed, collected and identified as a result of field works (2023-2024), from several localities of the, the plant has been detected in several regions of Sabha and from Ariggiba Region (Fig. 1). The collected specimens were treated with ordinary herbarium techniques (Pressing, drying, mounting, labeling). After critical investigations, the plant is identified as *E. glyptosperma*. The voucher specimens were deposited in the herbarium of the Botany Department (ULS), Faculty of Science, University of Sabah, using the data from several references [Smith & Tutin, 1968; Pahlevani & Riina, 2011; Hutchinson & Al. 2014; Flora of North America Editorial Committee, 2016; Radcliffe-Smith, 2018; Smith, 2019]. The plant species was given voucher number (0289531N) (Fig.3).. The Voucher specimens were deposited in the same herbarium, with a duplicate sent to the herbarium of the Botany Department, Gharyan University, Gharyan, Libya (Fig.3).

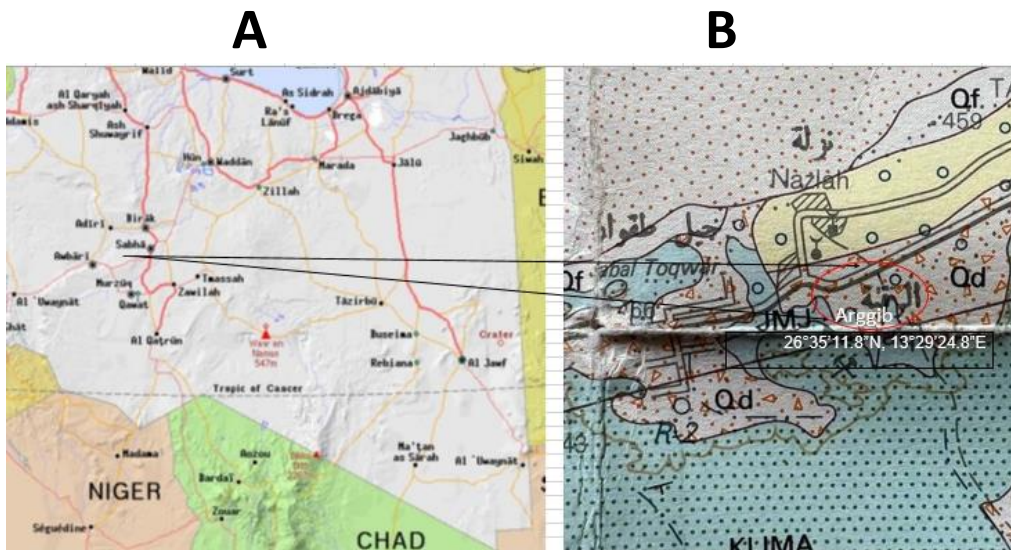


Figure 1. Map of Libya (A) and detailed map of the Sabha district (B) showing the locality where *Euphorbia glyptosperma* was collected & longitude and latitude location.

Description of Species

Accepted name: *Euphorbia glyptosperma* Engelm. Rep. U.S.-Mexico. Bound. 2(1): 187. 1859.

Synonyms: Synonym: *Chamaesyce glyptosperma* (Engelm.) Small in Fl. S.E. U.S.: 712 (1903).

English common name: rib seed sandmat, corrugate-seeded spurge, ridge-seeded spurge.

Euphorbia glyptosperma Engelm, commonly known as the ridge-seeded spurge, is an herbaceous annual plant typically growing in a prostrate or decumbent habit, with slender, branching stems that can reach up to 30 cm in length. The stems are reddish-green. The leaves are narrow and elongated, generally linear to oblong in shape, measuring 3-15cm×2-7 mm wide. The leaf blades have a smooth, glabrous surface and a distinct midvein running the length of the leaf (Fig.2). The leaf margins are slightly serrulated, and the tips are Acute (Sirbu & Şuşnia, 2018). The plant's inflorescence is composed of small, cup-shaped structures called cyathia, which are distinctive features of the *Euphorbia* genus. The cyathia of *E. glyptosperma* are generally 1-2 mm in diameter and feature four or five greenish-yellow glands surrounded by small appendages (Fig.2). The cyathia are arranged in clusters at the stem tips and branch axils (Geltman, 2020). The most distinguishing characteristic of this species is its seeds, which are the source of the common name “ridge-seeded spurge”. The seeds are approximately 1-1.5 mm long and have a sharply 3-sided,

pyramidal shape. The seed surface is prominently sculptured with transverse ridges or grooves, creating a unique and visually distinctive pattern (Sîrbu & Şuşnia, 2018). *Euphorbia glyptosperma* Engelm is native to western North America but has been documented in parts of North Africa, including Libya. The plant typically inhabits dry, sandy, or gravelly areas, roadsides, and disturbed sites.

Distribution: It is native in North America, where it is one of the most widespread species of the genus [Berry & et al., 2016], and introduced in Europe [Roux, 1992; Hügin & Starlinger, 1997; Hügin, 1999] and Asia (Geltman & Medvedeva, 2017).

Habitat: *Euphorbia glyptosperma* Engelm grows well in a wide range of soil types, from clayey, dry soils, and it is widely adapted to harsh urban environments (Sîrbu & Şuşnia, 2018)

Chromosome number: *Euphorbia glyptosperma* is a diploid species ($2n=22$) (Sîrbu & Şuşnia, 2018., Berry et al., 2016).

Voucher specimen: Specimen examined- colonies of this plant near dried water bodies and wastelands of (Ariggiba region 26°35'11.8" N, 13°29'24.8" E) located approximately 110 km west-south of the Sabha region of Libya, about 1000 km south of Tripoli (Fig.1). In addition, the plant has been detected in several regions of the Sabha.

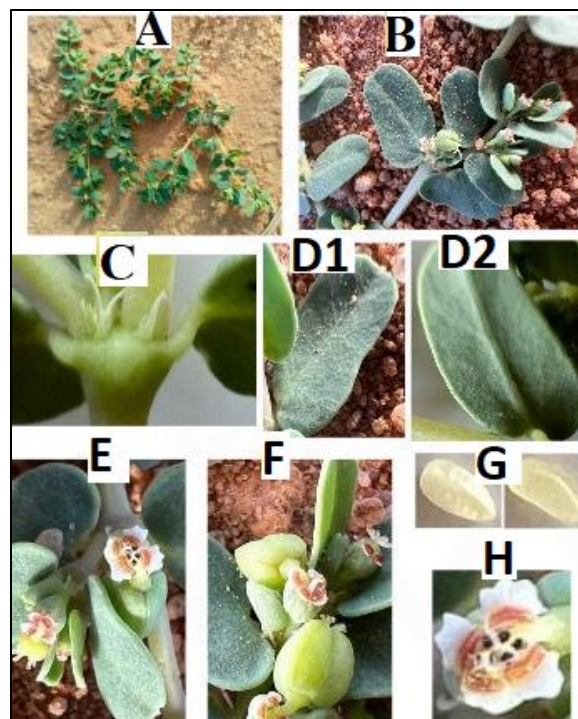


Figure 2. *Euphorbia glyptosperma*: A) Habit; B) Flowering stalk; C) White membranous scale composed of united stipules at the base of the

leaves; **D)** Leaves (**D1.** abaxial surface, **D2.** adaxial surface); **E)** Inflorescence; **F)** Capsule, top view and lateral view; seeds; **H)** Flower showing petaloid appendage extending from the rim of cyathium.

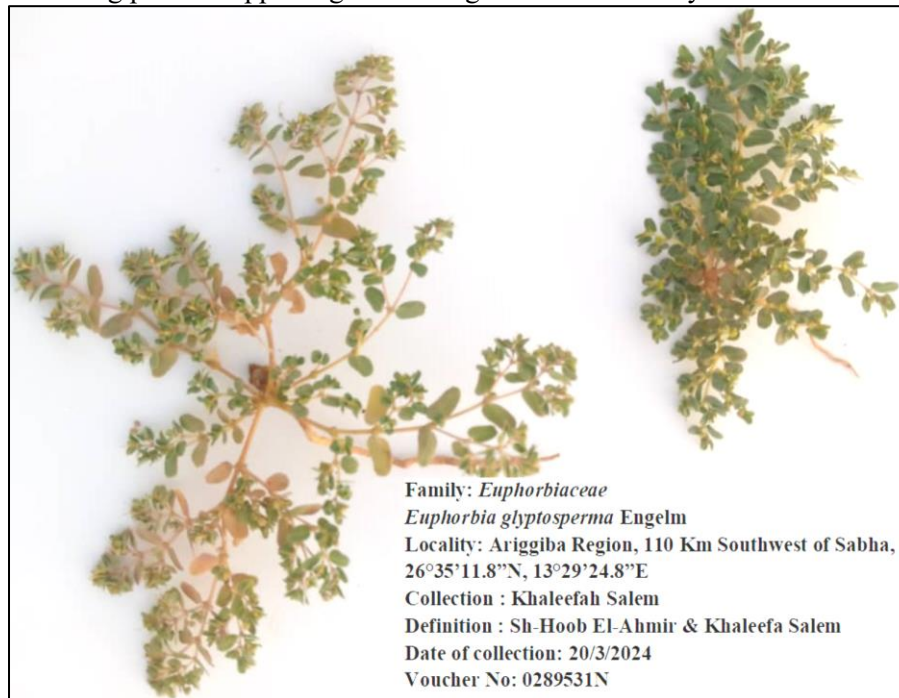


Figure 3. Herbarium specimen of *Euphorbia glyptosperma* Engelm collected from Ariggiba, 110 Km southwest of Sabha, and several regions of Sabha

Results

The native distribution of *E. glyptosperma* is primarily concentrated in North America, including New England, where its presence is rare. The species thrives in open, sandy areas such as railroads, roadsides, and fields. While it is likely native to much of the central United States, its occurrence in regions like eastern Canada is primarily in highly disturbed habitats, suggesting it may be adventive in those areas. Its prominently ridged seeds, laciniate stipules, complete lack of pubescence, and somewhat obscure toothing near the tips of the leaves characterize *Euphorbia glyptosperma*. In this study, *E. glyptosperma* is reported for the first time in Sabah and the Ariggiba region of Libya. In Libya, the genus *Euphorbia* is represented by 30 species, as reported in the Flora of Libya encyclopedia (Kieth, 1965; Jafri & El-Gadi, 1982) and recent studies (Sharashy, 2016; Mahklouf, 2023; Al-Shaari & Makhoulf, 2023). The present study reports a new record of *Euphorbia glyptosperma* Engelm. for the flora of Libya, which will increase the number of *Euphorbia* species in the country to 31 (Table 1).

Table 1. A list of new records *Euphorbia* species was added to the Flora of Libya in a recent publication

Species	Distribution in Libya	Recorded by
<i>Euphorbia punctata</i>	different parts of Libya	Sharashy, 2016
<i>E. hypericifolia</i>	Tobruk city in north-eastern Libya	Mahklouf, 2023
<i>E. hirta</i>	Gabe's region, belonging to Tobruk city in the northeast part of Libya	Al-Shaari & Mahklouf, 2023
<i>E. glyptosperma</i>	several regions of Sabha and from the Ariggiba Region	This study

The results of this study demonstrate the broad global distribution of *Euphorbia glyptosperma*, which extends well beyond its native range in North America, where it is one of the most widespread species of the genus (Sîrbu & Şuşnia, 2018). The species has shown a remarkable ability to adapt and thrive in a variety of tropical, subtropical, and warm temperate regions around the world, likely facilitated by its adaptability and tolerance to diverse environmental conditions. *E.glyptosperma*, commonly known as the ridge-seeded spurge, is native to western North America. Its native range spans parts of the United States, including Texas, New Mexico, and Arizona (USDA, 2023). *E.glyptosperma* typically inhabits dry, sandy, or gravelly areas, roadsides, and disturbed sites. The species is adapted to thrive in arid and semi-arid environments, making it well-suited to the climatic conditions found in parts of Libya. The introduction of *E. glyptosperma* to North Africa, including Libya, is likely the result of a combination of factors. One possible pathway is through the unintentional dispersal of the plant's distinctive, ridge-patterned seeds via human activities, such as the transport of agricultural products or the movement of people and goods. Another potential reason for the species' presence in North Africa could be the intentional introduction of *E. glyptosperma* for ornamental or medicinal purposes. The plant's unique morphological features, particularly the sculptured seeds, may have made it an appealing addition to botanical gardens or traditional medicine practices in the region.

Key to the genus *Euphorbia* in Libya

Since the key to the genus *Euphorbia* in the *Flora of Libya* covers only 31 species, this study presents an updated classification key that incorporates all the additional species included in the *Encyclopedia of Libyan Plants*.

- 1a. Plants woody or shrub-like, with persistent stems 2
- 1b. Plants herbaceous, annual or perennial, without persistent woody stems ...8
- 2a. Large shrubs or small trees, usually with thick, succulent branches 3
- 2b. Small, non-succulent shrubs, or with thin branches 5
- 3a. Leaves alternate, narrow, with milky sap *E. dendroides*
- 3b. Leaves opposite or whorled, broader 4
- 4a. Stem thick, often multi-branched; leaves broad *E. characias*
- 4b. Stem less thickened; leaves narrower *E. bivonae*
- 5a. Leaf margins distinctly serrate *E. serrata*
- 5b. Leaf margins entire or slightly undulating 6
- 6a. Leaves densely hairy *E. guyoniana*
- 6b. Leaves glabrous or sparsely hairy 7
- 7a. Plant with spiny structures on stems *E. spinosa*
- 7b. Plant without spines ... *E. terracina*
- 8a. Plants succulent or semi-succulent 9
- 8b. Plants non-succulent, thin-leaved 12
- 9a. Plants creeping or prostrate, found near coastal habitats *E. paralias*
- 9b. Plants upright or sprawling, not necessarily coastal 10
- 10a. Stems and leaves with dense glandular hairs *E. calyptrata*
- 10b. Stems and leaves mostly glabrous 11
- 11a. Leaves elongated, margins slightly curled *E. pithyusa*
- 11b. Leaves rounded or oval, margins entire *E. retusa*
- 12a. Plants prostrate or creeping 13
- 12b. Plants erect or ascending 16
- 13a. Stems reddish, often seen in disturbed habitats *E. peplus*
- 13b. Stems green, usually found in sandy soils 14

14a. Leaves small, deeply lobed	<i>E. peplis</i>
14b. Leaves broader, slightly toothed or entire	15
15a. Leaves slightly serrated, glandular	<i>E. granulata</i>
15b. Leaves smooth, not glandular	<i>E. pseudoapios</i>
16a. Leaves deeply lobed or divided	17
16b. Leaves entire or slightly toothed	19
17a. Leaf margins highly dissected, almost thread-like	<i>E. dracunculoides</i>
17b. Leaf margins shallowly lobed, not thread-like	18
18a. Stems thin and wiry, flowers small	<i>E. parvula</i>
18b. Stems more robust, flowers larger	<i>E. exigua</i>
19a. Milky latex abundant, leaves thick	<i>E. falcata</i>
19b. Milky latex sparse or absent, leaves thinner	20
20a. Seeds deeply grooved, plants often found in dry habitats	<i>E. sulcata</i>
20b. Seeds smooth or slightly ridged	21
21a. Leaves opposite, veins prominent	<i>E. hirta</i>
21b. Leaves alternate or irregularly arranged	22
22a. Plants with a spreading or creeping habit	<i>E. glyptosperma</i>
22b. Plants upright, more compact	23
23a. Leaves narrow, linear, arranged alternately	<i>E. punctata</i>
23b. Leaves broader, sometimes oval	24
24a. Flowers small, clustered at leaf axils	<i>E. hypericifolia</i>
24b. Flowers in terminal or subterminal clusters	25
25a. Stems hairy or slightly rough	<i>E. squamigera</i>
25b. Stems smooth, glabrous	26
26a. Seeds smooth, dark brown	<i>E. heterophylla</i>
26b. Seeds ridged or granular	27
27a. Plants found in disturbed urban or roadside environments	<i>E. chamaesyce</i>
27b. Plants found in drier, sandy environments	<i>E. forkaoslii</i>

Conclusions

This study has documented the expanding global distribution of *E. glyptosperma*, a plant species that is native to western North America. The findings demonstrate the species' ability to naturalize and establish populations beyond its native range, including the first recorded occurrence of its presence in Libya's flora. The distribution of *E. glyptosperma* in Libya and other parts of North Africa can be attributed to a combination of factors, including unintentional dispersal, intentional introduction, and the species' adaptability to the regional environmental conditions.

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