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First record of *Coronilla valentina* (Fabaceae) in Libya: Taxonomic and ecological perspectives

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Abstract
This study documents the first record of *Coronilla valentina* L. (Fabaceae) from Wadi Om El-Amaym in the Al-Jabal Al-Akhdar in eastern Libya. Extensive morphological examinations, including a perennial subshrub habit, orbicular and caducous stipules, imparipinnate leaves, emarginated leaflets, umbeliform inflorescences with bright-yellow corollas, and terete pods with constricted seed chambers confirm the taxonomic identity of this species as *C. valentina*. Populations were found in rocky limestone slopes under a semiarid Mediterranean climate, resembling the calcareous habitats of native distribution in the western and central Mediterranean Basin. Historically, only *C. repanda* (Poir.) Guss, and *C. scorpioides* (L.) Koch were reported from Libya, and the floristic relevance of this finding and the necessity for further systematic botanical studies were emphasized. With new insights into legume phylogenomics and refined climate scenarios, this record reflects the dynamic Mediterranean plant diversity and the necessity to align conservation and sustainable horticulture efforts. The recorded ornamental role of *C. valentina* in the other Mediterranean areas clearly highlights its potential use in ecological restoration programs, considering the careful management of its *in-situ* populations.

Keywords: *Coronilla valentina*, Libyan flora, Mediterranean ecosystems, calcareous habitats, biodiversity

Introduction

The Fabaceae (*Leguminosae*) is one of the most ecologically and economically significant families of angiosperms, with an estimated 19,500-20,000 species occurring worldwide (Christenhusz & Byng 2016; Azani *et al.* 2017) [3, 8]. Legumes exhibit tremendous morphological and ecological diversity and contribute significantly to ecosystem functioning through nitrogen fixation, soil stabilization, and support of diverse pollinator networks (Graham & Vance, 2003; Sprent, 2009) [12, 21]. Recent advances in next-generation sequencing and phylogenomic analyses have profoundly enhanced our understanding of legume evolution, facilitating a more robust resolution of phylogenetic relationships (Bruneau et al., 2013) [5].

Within the tribe Loteae (subfamily Papilionoideae), the genus *Coronilla* comprises approximately 50 species of annual or perennial herbs and small shrubs). These taxa are distributed across North and Central Europe, the Canary Islands, the Mediterranean region, North Asia, and some parts of China (Hutchinson, 1964; Piovan *et al.*, 1996; González-Melero *et al.*, 1997; Cano *et al.*, 2012) [7, 11, 13, 19]. However, considerable morphological overlap among species has long challenged taxonomic identification (Polhill, 1981; Cano *et al.*, 2012) [7, 20]. Although systematic and molecular approaches have contributed to resolving these complexities, as evidenced by the recent description of taxa such as *C. montserratii* from the Balearic Islands (Fraga & Rosselló, 2009) [10] and the documentation of *C. vaginalis* in Poland (Mirek *et al.*, 2015) [17], this genus remains poorly characterized, particularly in underexplored regions.

The Mediterranean Basin is recognized as one of the most biodiversity hotspots (Myers *et al.*, 2000; Blondel *et al.*, 2019) [4, 18], with a climate characterized by mild, wet winters and hot, dry summers. These conditions, coupled with predominantly calcareous soils, facilitate high levels of endemism and the persistence of calcicolous taxa such as *Coronilla*

(Jafri & El-Gadi, 1980 [15]; Tison *et al.*, 2014) [22]. In North Africa, representatives of *Coronilla* are mainly confined to coastal and subcoastal limestone outcrops. In Libya, floristic surveys have documented only *C. repanda* and *C. scorpioides* (Jafri & El-Gadi, 1980) [15]. The present study extends the known range of the genus by documenting the first record of *C. valentina* in Libya, thereby establishing critical data for regional biogeography, taxonomy, and conservation amidst accelerating climate change and anthropogenic disturbance (IPCC, 2021; Ali *et al.*, 2022) [1, 14].

Materials and Methods

Study Area and Sampling: Living plant materials of *Coronilla valentina* were collected from natural populations at Wadi Om El-Amaym in the Al-Jabal Al-Akhdar region of eastern Libya. The study area encompasses a north-south trending valley approximately 17 km in length, extending from its mouth at the Mediterranean Sea in the north to its inland terminus. The valley is flanked by Farzugha to the west and Al-Marj to the east. The precise geographic coordinates of sampling sites ranged from 20°45′00″ to 20°01′42″ E and 32°35′00″ to 32°01′15″ N (Figure 1). Elevation varied between sea level and approximately 380 m. The terrain is characterized by rocky limestone outcrops, calcareous slopes, and sparse herbaceous vegetation, a mosaic that typifies the Mediterranean calcareous habitat (Coste, 1901; Tison *et al.*, 2014) [9, 22]. Climatic records indicate a typical Mediterranean regime with mild, rainy winters and hot, dry summers, conditions that favor the persistence of calcicolous species.

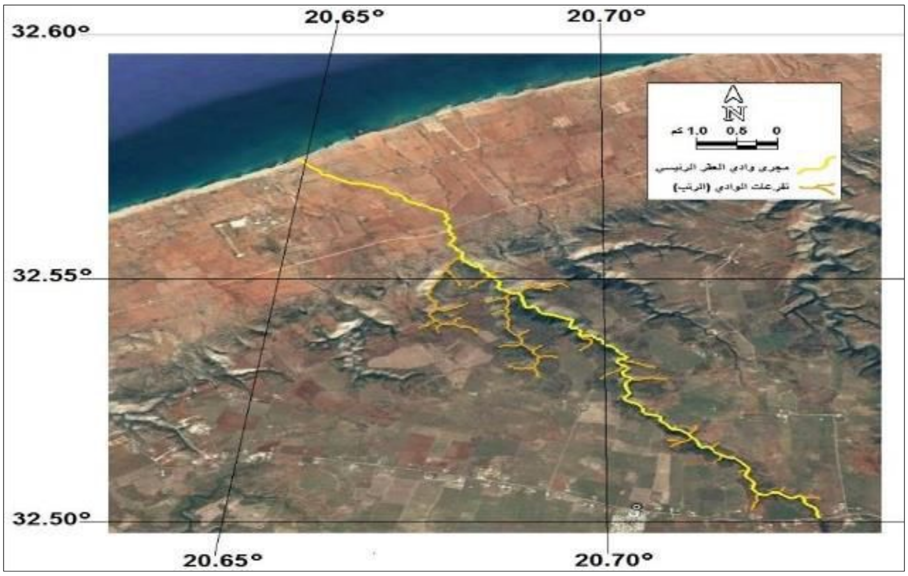

Fig 1: Map of the study area showing the geographical location of Wadi Om El-Amaym in the Al-Jabal Al-Akhdar region, Libya. The yellow line represents the course of the wadi from its inland origin to its terminus at the Mediterranean Sea. The map includes latitude and longitude coordinates for spatial reference and provides an overview of the topographical and ecological context of the study site.

Field Collection and Voucher Preparation

Field surveys were conducted during the flowering and fruiting periods in March and April over the 2021-2022 seasons, coinciding with peak phenological expression. A stratified random sampling design was employed, with five to ten individuals per site selected to capture intrapopulation variability. Detailed records were maintained at each site using a high-precision GPS, and comprehensive habitat descriptions-including associated flora-were documented. Plant specimens were collected in their entirety (encompassing roots, when possible, stems, leaves, flowers, and mature pods) and were immediately pressed in the field. In the laboratory, specimens were oven-dried at 55-60°C for 2-3 days and subsequently mounted on herbarium sheets following standard protocols. Voucher specimens were deposited in the Tocra Herbarium (TOC) under accession numbers TOC 214, TOC 209, TOC 331, and TOC 332. Specimens were compared against herbarium reference collections and standard taxonomic keys (Jafri & El-Gadi, 1980; Tutin *et al.*, 1968; Tison *et al.*, 2014) [15, 22, 23] to ascertain species identity.

Morphological Examination: Morphological characters were evaluated using both macroscopic observation and stereo microscopy (10×-40× magnification). Documented diagnostic characters included overall growth habit, leaf architecture (number, shape, and size of leaflets), stipule morphology (with emphasis on orbicular shape and deciduous nature), inflorescence configuration, and floral coloration, dimensions of the calyx and corolla, and fruit (pod) morphology. Measurements were taken from both fresh field specimens and later verified on pressed materials to ensure consistency. In addition, a microscope was employed to capture high-resolution images of seed surface microstructure. Quantitative data were compiled from measurements taken on ten representative leaves and flowers per specimen, and descriptive statistics (means and ranges) were calculated. These morphometric data were subsequently compared with published descriptions (Cano *et al.*, 2012; Fraga & Rosselló, 2009) [7, 10] and contextualized with recent phylogenomic insights (Bruneau *et al.*, 2013) [5].

Data Analysis and Comparison: The morphometric data were statistically analyzed to ascertain diagnostic thresholds for key quantitative traits such as leaflet length, calyx length, corolla length, and peduncle length. A comparative table (Table 1) describes the diagnostic differences between *C. valentina* and the two previously reported Libyan species (*C. repanda* and *C. scorpioides*). Combining classical morphological taxonomy with insights from recent molecular phylogenetics, this integrative approach provides robust evidence for species identification. It supports the taxonomic placement of the newly recorded populations within *Coronilla*.

Table 1: Key morphological characteristics of three *Coronilla* species found in Libya. The table compares key features including duration, stipule morphology, leaflet number and shape, floral traits, and corolla attributes among *C. valentina, C. scorpioides,* and *C. repanda*. These characteristics aid in distinguishing between the species based on their structural variations.

Characters	***C. valentina***	***C. scorpioides***	***C. repanda***
Duration	perennial	Annual	Annual
Stipule	orbicular	Connate	Connate
Stipule appearance	deciduous	Persistent	Persistent
Number of leaflets	4-6 pairs	One pairs	2 pairs
Length of the terminal leaflet (mm)	20 mm	8 mm	8-20 mm
Leaflet shape	Homomorphic. obovate	Heteromorphic: oblong-ovate to elliptic, sometimes mucronulate	Heteromorphic: oblong-obovate to oblong-elliptic, mucronulate at base
Number of flowers	4-14-flowered terminally	(1) 2-4-flowered terminally	(1-) 2-4-flowered terminally
Calyx length (mm)	3-4 mm	1.5-2.5 mm	2-2.5 mm
Corolla length (mm)	Up to 16 mm	Up to 9 mm	Up to 9 mm
Corolla colour	Yellow	Yellow with purplish veins	Yellow with purplish veins

Results: All examined specimens from Wadi Om El-Amaym exhibited a uniform set of morphological characteristics diagnostic of *Coronilla valentina* L. Plants consistently exhibited a perennial subshrub growth form, attaining heights of up to 100 cm, with glabrous and glaucous stems imparting a characteristic silvery-green appearance. At the base of each leaf, orbicular, deciduous stipules were present. The leaves were moderately fleshy and imparipinnate, bearing (2)4-5(6) pairs of obovate, emarginated leaflets, each reaching a maximum length of 20 mm. Inflorescences were arranged in rounded, umbel-shaped clusters on peduncles approximately 7 cm long. Each inflorescence comprised 4-14 bright-yellow flowers. Detailed floral analysis revealed a glabrous calyx with five triangular teeth measuring approximately 3-4 mm and a corolla extending up to 16 mm, approximately three to four times the calyx length. The fruiting bodies were terete pods, distinctly constricted between seeds, which turned dark brown upon drying; the seeds were oblong (approximately 2-3 × 1 mm), brownish-green, and exhibited a smooth surface texture.

Field observations indicate that *C. valentina* is confined to rocky limestone slopes within a semiarid Mediterranean environment as shown in Figure 3 and Figure 4. The calcareous substrate, characterized by thin, alkaline soils interspersed with scattered shrubs and drought-adapted herbaceous species, is consistent with habitats reported for this taxon across the western and central Mediterranean Basin (Coste, 1901; Tison *et al.*, 2014) [9, 22]. The flowering period, primarily observed in mid-spring (March-April), corresponds with the seasonal climatic cycle; however, recent climate projections (IPCC, 2021; Ali *et al.*, 2022) [1, 14] suggest that such cycles may become increasingly erratic. The morphological data, in conjunction with recent phylogenomic studies (Bruneau *et al.*, 2013) [5], unequivocally support the taxonomic identification of these populations as *C. valentina* and represent a significant extension of the known distribution of *Coronilla* in Libya—a region previously known only to harbor *C. repanda* and *C. scorpioides* (Jafri & El-Gadi, 1980) [15].

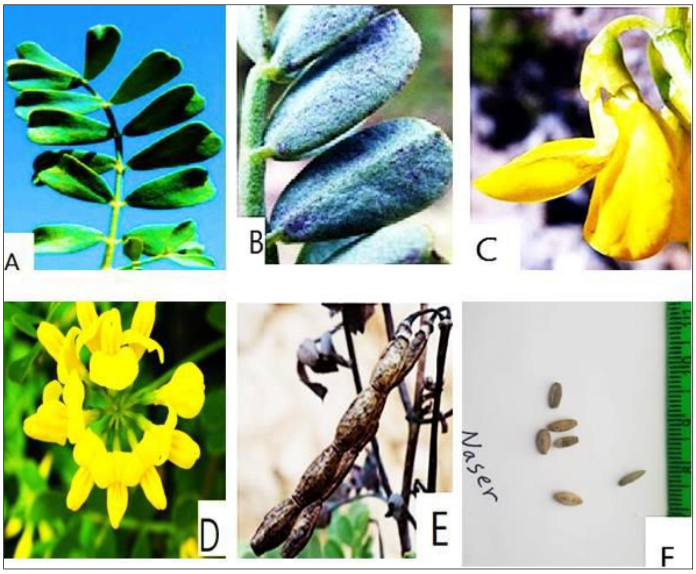

Fig 2: Morphological characteristics of *Coronilla valentina*. (A) Leaf with multiple pairs of leaflets. (B) The abaxial surface of a leaflet shows texture and coloration. (C) Close-up of a flower highlighting the yellow corolla. (D) Inflorescence displaying a cluster of flowers. (E) Dry pod with characteristic seed arrangement. (F) Seeds with a size reference for comparison.

Fig 3: Habitat and growth form of *Coronilla valentina* in Wadi Om El-Amaym, Al-Jabal Al-Akhdar, Libya. The figure depicts the plant growing on rocky limestone substrates, characteristic of its calcicolous habitat. The plant exhibits a sprawling subshrub growth form with imparipinnate leaves and bright yellow flowers arranged in umbel-like inflorescences.

Fig 4: Field image of *Coronilla valentina* showing its natural occurrence and reproductive structures. The figure highlights the plant's ecological association with Mediterranean limestone habitats, displaying its distinct foliar architecture, inflorescence structure, and developing seed pods. These observations support its adaptation to semiarid calcareous environments in Libya.

Discussion

The currently recorded presence of *Coronilla valentina* in the Al-Jabal Al-Akhdar area is a notable biogeographical distribution that enriches Libya's floristic inventory. Previous reports of the genus from Libya were limited to *C. repanda* and *C. scorpioides* (Jafri & El-Gadi, 1980) [15]. In parallel to earlier findings, the presence of *C. Valentina* on rocky limestone substrates is consistent with its ecological status as a calcicolous species, a character typical of Mediterranean legumes. The diagnostic morphological features seen in the type of material, especially the orbicular, deciduous stipules, the imparipinnate leaf architecture, and the umbel-shaped inflorescences, consisted with the descriptions in the literature (Cano *et al.*, 2012; Fraga & Rosselló, 2009) [7, 10], and this is now supported by recent molecular assessment (Bruneau *et al.*, 2013) [5].

Ecologically, the specialized habitat of *C. valentina* is noteworthy. The Mediterranean climate is semiarid, with pronounced seasonality and calcareous soils, because of which a distinctive calcicolous assembly of species can be supported. However, these habitats are becoming more vulnerable to climate change and anthropogenic disturbance. However, these habitats are increasingly susceptible to climate change and anthropogenic disturbance. Recent projections by the Intergovernmental Panel on Climate Change (IPCC, 2021) [14] indicate that Mediterranean regions may experience significant alterations in precipitation regimes and temperature patterns, potentially leading to habitat fragmentation and loss of biodiversity. Furthermore, local pressures (e.g., agricultural development, overgrazing, and quarrying) exacerbate the risks (Le Houérou, 2001; Tison *et al.*, 2014) [16, 22].

The ornamental potential of *C. valentina*, as evidenced by its use in parts of Italy (Cacciola *et al.*, 2002) [6], suggests opportunities for its integration into sustainable horticulture and ecological restoration initiatives. However, any ex-situ utilization must be balanced by stringent in-situ conservation measures to protect the genetic integrity of natural populations. Future studies employing integrative taxonomic approaches, including combining detailed morphometric analysis with high throughput molecular phylogenetics (Bruneau *et al.*, 2013) [5], are essential to unravel *Coronilla*'s evolutionary relationships and detect potential cryptic speciation.

Further floristic surveys across underexplored limestone areas of North Africa, coupled with detailed monitoring of population dynamics, are crucial for developing effective conservation strategies. To inform adaptive management practices, these efforts should also consider the potential impacts of rapid climatic changes, as highlighted by recent climate models (IPCC, 2021; Ali *et al.*, 2022) [1, 14].

Conclusion

This study establishes the first confirmed record of *Coronilla valentina* in eastern Libya, expanding the documented range of the genus and reinforcing the country's plant diversity. Morphological evidence-particularly the orbicular, deciduous stipules, multileaflet arrangement, and yellow umbel-shaped inflorescences—differentiates *C. valentina* from the two previously reported species, *C. repanda* and *C. scorpioides*. Occurring on rocky limestone slopes under a semiarid Mediterranean climate, *C. valentina* exemplifies a calcicolous species adapted to challenging habitats. As climate change and anthropogenic pressures intensify, ongoing surveys and integrative research (combining morphological and molecular tools) will be critical to understanding and conserving these valuable Mediterranean legumes.

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