

**FIRST RECORD OF *COLCHICUM TRIPHYLLUM* (COLCHICACEAE) FROM
HIGH ALTITUDE IN NORTHEASTERN ALGERIA**

KHELOUFI Abdenour^{1*}

Abstract: We report the first sighting of *Colchicum triphyllum* Kunze, from the Belezma National Park (BNP, Batna, Northeastern Algeria) at 1802 m a.s.l. (Latitude 35°33' N, Longitude 5°58' E). *C. triphyllum* is known to be present in the North of Algeria, but its presence had not been confirmed at high altitudes. The observation of a population of 139 flowering individuals and 47 individuals at vegetative growth had taken place in April 2023 while conducting ecological surveys. The species is suggested to be distributed at elevations ranging from sea level to 1500 m a.s.l. This finding of a population of *C. triphyllum* at 1802 m a.s.l. in the BNP represents a new high-altitude register for this species. The paper describes its distribution, biology, morphology, ecology, phenology, and also its medicinal properties. Conservation efforts may be necessary to protect and increase the population size of this rare species.

Keywords: *Colchicum triphyllum*, Belezma National Park, Distribution, Ecology, Conservation

Received: 29 May 2023 / Accepted: 13 October 2023

Introduction

Colchicum belongs to the family Colchicaceae and is a genus consisting of perennial plants. These particular plants are widely recognized as autumn crocuses, meadow saffrons, or naked ladies. The genus encompasses approximately 160 species, naturally occurring in Europe, Asia, and North Africa. Certain species of *Colchicum* have additionally been introduced to various regions outside their native range, including North America, South America, and Australia, where they may have established themselves as naturalized plants (Chacón et al. 2014).

Among the Liliales, the Colchicaceae family holds the position of being the third largest family, following the Liliaceae and Smilacaceae families (Vinnersten & Manning 2007). The genus *Colchicum* is renowned for its notable anti-inflammatory and analgesic properties, which are primarily attributed to the presence of the alkaloid colchicine (Vinnersten & Larsson 2010). *Colchicum* has a long history of traditional use as a remedy for gout, effectively reducing the frequency and severity of gout attacks. Nevertheless, it is important to note that the genus contains various toxic alkaloids, including colchicine. Ingesting large quantities of these alkaloids can lead to severe poisoning (Nuki 2008, Larsson & Ronsted, 2014, Mykhailenko et al. 2022). Despite the inherent toxicity, certain species of *Colchicum* are cultivated for their ornamental value due to their captivating flowers, which exhibit a range of attractive colors.

The genus is most diverse in the eastern Mediterranean region, where the highest number of species is found. According to the Catalogue of Life (2023), a comprehensive online database of all known species, there are currently 35 species of *Colchicum* that are native to the Mediterranean region, with 16 species listed in North

¹ Department of Ecology and Environment, University of Batna 2, 05078 Batna, Algeria

* Correspondence: a.kheloufi@univ-batna2.dz

Africa (Dobignard & Chatelain (2010)). However, it is important to acknowledge that the taxonomy of the genus *Colchicum* is intricate and continually undergoing revision. Consequently, the number of recognized species and their distribution may undergo changes as new research findings emerge.

According to Quézel & Santa (1962), and Dobignard & Chatelain (2010), the genus *Colchicum* is represented in Algeria by several species viz. *C. neapolitanum*, *C. lusitanum*, *C. cupanii*, *C. bivonae*, *C. triphyllum*, *C. filifolium*, and *C. wysisianum*. *Colchicum triphyllum* Kunze is widely distributed in the Mediterranean region, including Algeria. Despite its abundance in Algeria, information on the species is rare, particularly regarding its distribution and ecology. This study provides the first confirmed record of *C. triphyllum* occurrence at high altitudes from the National Park of Belezma (Batna, northeastern Algeria).

The identification of a new population of *C. triphyllum* at high altitudes contributes to the taxonomic understanding of this plant species, and newly discovered information regarding the potential medicinal properties of this species. The discovery of a new population of *C. triphyllum* also presents opportunities for further scientific research. Researchers can investigate the genetic variation, reproductive biology, and adaptability of this population, which can enhance our understanding of plant evolution and adaptation to different environments.

Material and methods

The Belezma National Park (BNP) is located in Batna (Northern East of Algeria) and it covers an area of about 262 km². It has an arid climate with dry-hot summers and wet-cold winters. The annual average precipitations over the last 10 years (2013-2022) vary between 162.82 and 361.67 mm with an average of 252.9 ± 135.1 mm. Mean temperatures were 16.1 ± 0.62 °C with a maximum of 23.8 ± 0.92 °C and a minimum of 8.26 ± 0.42 °C (Tutiempo 2023). The BNP extends over high and medium altitudinal zones: Tichaou Mountain (Djebel, Dj.) with 2136 m, Dj. Touggour 2090 m, Dj. Kasserou 1641 m and Dj. Maaguel 1500 m. These peaks are characterized by a very rugged terrain, with narrow valleys and amount to 2136 m in Dj. Tichaou and over 2178 m in Dj. Rafâa. Snowfall is also common during the winter, particularly in the higher elevations of the park.

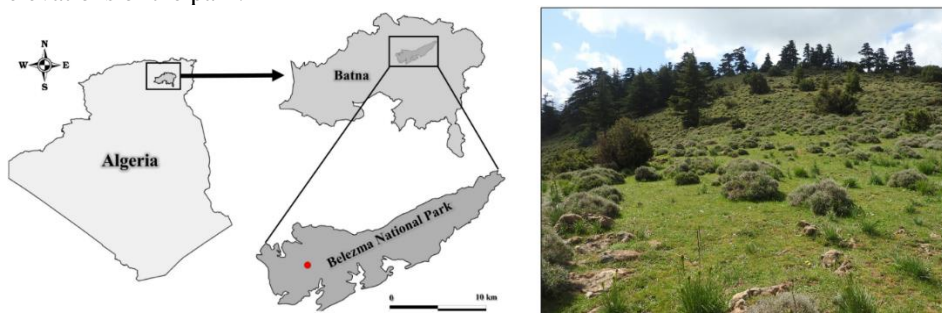


Fig. 1. Geographical location of the recorded population of *Colchicum triphyllum* (red point) and its habitat in the National Park of Belzma (NE-Algeria)

The observation of the population of *C. triphyllum* had taken place while conducting ecological surveys at high altitude in the BNP (Fig. 1). Plant material was

photographed and a number of 10 flowering individuals were randomly selected for measurement and the herbarium collection. The morphological characters were measured. The plant standing height, leaf sheath length, leaf sheath diameter, root length, bulb length, and bulb diameter were evaluated in the laboratory using a measuring tape (0.01 cm) or digital caliper (0.01 mm), and the number of plant flowers and roots were counted by visual observation. The plant standing height was measured from the basal part of the leaf sheath (i.e. also the top of the bulb) to the tip of the longest leaf. Leaf sheath length was recorded from the basal part of the leaf sheath to the beginning of the first leaf. The largest diameter of the leaf sheath (nearly 1 cm above the top of the bulb) was recorded as the leaf sheath diameter.

The soil was also analyzed for some chemical characteristics. The geographical coordinates were recorded using a Magellan eXplorer 200 GPS Receiver. The taxonomy and nomenclature of species follow Dobignard & Chatelain (2010).

Results and discussion

Taxonomy. *Colchicum triphyllum* Kunze (1846) belongs to the plant family Colchicaceae and the genus *Colchicum*. The species was first described by the French Botanist Louis Claude Richard in 1808. Taxonomically, *C. triphyllum* has undergone several revisions and taxonomic changes over the years. Some sources consider it a synonym of *Colchicum bornmuelleri*, while others recognize it as a distinct species. According to Dobignard and Chatelain (2010), the synonyms of *C. triphyllum* are: *Fouha bulbocodioides* Pomel (1860), *Colchicum bulbocodioides* Kunth and *Colchicum montanum* auct. The common names *autumn crocus*, *meadow saffron*, and *naked lady* may be applied to the whole *Colchicum* genus or many of its species. The voucher specimen (K000464108) by the Royal Botanic Garden Kew is illustrated in Figure 2.



Fig. 2. Voucher specimen (K000464108). Royal Botanic Garden Kew

Distribution. Geophyte plants are typically classified within botanical families such as Liliaceae, Amaryllidaceae, Ranunculaceae, Iridaceae, Primulaceae, Araceae, Geraniaceae, and Orchidaceae, and many of them possess economic and medicinal value. The distribution of *C. triphyllum* encompasses various regions, including the arid and cold areas of the Iberian Peninsula in the southwest, southeastern Europe (Turkey and Greece), northern Africa, and Asia Minor. This species is known to thrive across altitudes ranging from sea level to approximately 1500 meters above sea level (Nualart et al. 2017). It typically flourishes in dry meadows, open grasslands growing on rocky, somewhat arid, calcareous substrates, in high mountain regions, and predominantly on limestone-based soils (Malo & Shuka 2013). The discovery of a *C. triphyllum* population at an elevation of 1802 m within the Belezma National Park (BNP) (NE-Algeria) represents a noteworthy addition to the known altitudinal range for this species, marking a new high-altitude record.

Population size and morphology. The population of 139 individuals and 47 individuals at vegetative growth of *C. triphyllum* was recorded on the 14th of April 2023 in the BNP at 1802 m a.s.l. (Latitude 35°33' N, Longitude 5°58' E) (Fig. 1). The population was recorded at the flowering stage in only one area that not exceeding 50 m². The size and structure of the population may be influenced by several factors such as habitat fragmentation, overgrazing, and the collection of the plant for medicinal purposes. The population of *C. triphyllum* found in the Belezma National Park represents a new record for the species in high-altitude areas in Algeria. The small population size and restricted distribution of *C. triphyllum* in the BNP highlight the need for conservation efforts to protect and increase the population size of the species. The study recommends measures such as habitat restoration, the implementation of regulations to limit the collection of the plant for medicinal purposes, and the creation of a conservation program to monitor the population and its response to environmental changes.

The morphological characteristics of ten flowering individuals of *C. triphyllum* that were sampled from the BNP (NE-Algeria) are shown in Table 1.

Table 1. Morphological characteristics of *Colchicum triphyllum* at flowering phase (n=10)

Parameters	Mean	SD	min-max	CV (%)
Standing height (cm)	8.72	1.21	7.22-10.82	14.41
Root length (cm)	4.91	0.36	4.36-5.23	7.26
Leaf-sheath length (cm)	4.47	1.16	3.24-6.53	26.02
Leaf-sheath diameter (cm)	0.43	0.05	0.36-0.51	12.53
Bulb length (cm)	1.98	0.38	1.67-2.66	18.99
Bulb diameter (cm)	1.26	0.08	1.12-1.34	6.45
Flower number	1.6	0.7	1-3	43.71
Root number	30.6	10.74	14-42	35.11

Abbreviations: SD - standard deviation; CV - coefficient of variation

According to Quézel & Santa (1962), species of the genus *Colchicum* (Colchicaceae) are perennial, bulbous plants. Depending on the species, *Colchicum* plants either have flowers and leaves that develop simultaneously (synanthous plants) or leaves and fruits that develop in autumn (hysteranthous plants). The leaves are all basal and surrounded by a spathe-like sheath along with the flowers. The inflorescence of *C. triphyllum* consists of 1-3 flowers that are borne on a long peduncle (Fig. 3). The

perianth is petaloid, fused at the base into a pedunculate tube and spread at the top into 6 divisions, forming a funnel-shaped structure. The flowers are usually pale pink or white, although they can also be tinged with purple. Each flower has six petals that are fused at the base to form a narrow tube, which opens into a wide, flat corolla with a diameter of 2-4 cm. The flowers have a characteristic sweet fragrance and are pollinated by insects. There are 6 stamens with dorsifixed anthers. The ovary has 3 multiovulate chambers. The capsule is septicial. The fruit of *C. triphyllum* is a three-chambered capsule that contains numerous small, black seeds. The seeds are dispersed by ants and small mammals. The seeds are numerous and subglobose. It has two linear or linear-lanceolate leaves. The leaf blade is divided and measures 12-25 mm in length, with only 5-7 veins. The anthers are linear. The capsule has carpels contracted into a short beak. The bulb has brown tunics. It blooms from October to December in clearings, sandy areas, pastures, and alluvial zones.



Fig. 3. Individuals of *Colchicum triphyllum* from the Belezma National Park (NE-Algeria)

Ecology and reproductive biology. *C. triphyllum* is characterized as a perennial herbaceous plant that blooms in both spring and autumn. It is commonly found in rocky and stony environments, often occupying slopes and hillsides within Mediterranean maquis and forest ecosystems. *C. triphyllum* demonstrates a well-adapted nature to the Mediterranean climate, characterized by hot, dry summers and mild, rainy winters. The plant's survival strategy involves growth from a corm, enabling it to enter a dormant

state during the dry season. The flowering period of *C. triphyllum* typically spans from February to April, contingent upon location and elevation. During this time, the plant produces one to three flowers that rely on insect pollination. In Mediterranean ecosystems, *C. triphyllum* holds significant ecological importance by providing sustenance and habitat for insects and other small animals. Its presence contributes to the diversity and stability of these ecosystems (Lentini & Raimondo 1984, Düşen & Sömbül 2007).

The phenology of *C. triphyllum* displays variability based on its specific location and environmental conditions. As a general pattern, the plant initiates growth in late winter or early spring, typically between the months of February and March. However, the precise timing of growth initiation is subject to variation, influenced by factors such as the plant's geographical location and elevation (Malo & Shuka 2013). *C. triphyllum* exhibits a distinct flowering period spanning from September to March. The plant's leaves emerge during the spring season and undergo withering as summer approaches. *C. triphyllum* develops fruit capsules that mature and disperse their seeds in late spring or early summer. During the hot and dry summer months, the plant enters a dormant state, with the corms remaining underground until the subsequent growing season (Samaniego & Velasco-Negueruela 1984).

In Algeria, studies have shown that the phenology of *C. triphyllum* is influenced by local environmental conditions, such as temperature and rainfall. For example, in the Tlemcen (NW-Algeria), the plant has been observed to grow and flower earlier in years with higher spring rainfall (Babali et al. 2018). The plant has a preference for soils that are rich in organic matter, and it has been reported to grow in soils with a pH range of 6.5 to 7.5. At the sampling site where *C. triphyllum* was found, the chemical characteristics of the soil were as follows: pH (1:1 water) 7.36, electrical conductivity (1:5 soil/water) 232.1 $\mu\text{S}\cdot\text{cm}^{-1}$. This soil is calcareous (48.4% total limestone) and very rich in organic matter (8.52%).

Medicinal properties. Plants within the Colchicaceae family are primarily employed in pharmaceutical applications due to their therapeutic properties, including anti-inflammatory and antitumor activities. These beneficial effects are attributed to the presence of colchicinoids, a group of alkaloids that includes colchicine and demecolcine (Alali et al. 2007, Cocco et al. 2010, Toplan et al. 2016). *C. triphyllum* holds a history of utilization in traditional medicine for diverse purposes, such as addressing gout, rheumatism, and edema. It is recognized that *C. triphyllum* contains multiple alkaloids, including colchicine and its derivatives, which possess toxicity towards both humans and animals (Terkeltaub et al. 2010). These compounds are thought to serve as protective mechanisms for the plant, shielding it against herbivores and pathogens. Furthermore, the pharmaceutical industry utilizes these alkaloids to develop drugs aimed at treating conditions such as gout, rheumatism, and cancer (Siddiqui et al. 2022).

According to Senizza et al. (2020), in vitro studies have demonstrated that *C. triphyllum* leaf extracts exhibit robust antioxidant capacity. Additionally, each methanolic extract of *C. triphyllum* tested exhibited activity against the enzyme tyrosinase. Significant correlations were observed between the plant's phytochemical profiles, primarily lignans and tyrosol equivalents, and the observed activities. Despite the presence of toxic alkaloids, such as colchicine, this research supports the use of various extraction methods to produce extracts that are rich in (poly)phenols and alkaloids. These extracts contribute significantly to antioxidant properties and other

pharmacological effects, making *C. triphyllum* a promising source for drug development and whitening agents in the food, pharmaceutical, and cosmetic industries.

Conclusions

Colchicum triphyllum has previously been documented in North Africa and several parts of Europe. However, the present study marks a significant milestone as it offers the first recorded instance of *Colchicum triphyllum* Kunze thriving at high altitudes in Northeastern Algeria. This groundbreaking discovery underscores the importance of conducting further research on this species to gain deeper insights into its distribution and ecology within the country. In contrast to other known populations of *C. triphyllum* in Algeria and across the globe, it becomes evident that the population discovered within the Belezma National Park is relatively small in size. This observation raises questions about the factors influencing its structure and ecological dynamics, especially when compared to more established populations in other regions.

Acknowledgements. The author is very grateful to Dr. Errol Vela (University of Montpellier in conjunction with CIRAD, International Agricultural Research Centre for Development, Paris, France) and Pr. Farid Bekdouche (University of Batna 2, Algeria), for their assistance in confirming the identification of *Colchicum triphyllum*.

References

- Colchicum L. in Catalogue of Life (2023). Checklist dataset accessed via catalogueoflife.org on 2023-05-01.
- Alali, F.Q., Tawaha, K. & El-Elimat, T. (2007). Determination of (-)-demecolcine and (-)-colchicine content in selected Jordanian *Colchicum* species. *International Journal of Pharmaceutical Sciences*, 62, 739-742.
- Babali, B., Bouazza, M. & Merzouk, A. (2018). La diversité végétale de la forêt de Moutas-Tlemcen. *Revue Ecologie-Environnement*, 14, 2.
- Düşen, O. D. & Sümbül, H. (2007). A morphological investigation of *Colchicum* L.(Liliaceae) species in the Mediterranean region in Turkey. *Turkish Journal of Botany*, 31(5), 373-419.
- Chacón, J., Cusimano, N. & Renner, S. S. (2014). The evolution of Colchicaceae, with a focus on chromosome numbers. *Systematic Botany*, 39(2), 415-427.
- Cocco, G., Chu, D.C. & Pandolfi, S. (2010). Colchicine in Clinical Medicine. A Guide for Internists. *European Journal of Internal Medicine*, 21, 503–508.
- Dobignard, A. & Chatelain, C. (2010). Index synonymique de la flore d'Afrique du Nord, volume 1, Pteridophyta, Gymnospermae, Monocotyledoneae. Editions des Conservatoire et Jardin botaniques de la Ville de Genève.
- Larsson, S. & Ronsted, N. (2014). Reviewing Colchicaceae alkaloids—perspectives of evolution on medicinal chemistry. *Current Topics in Medicinal Chemistry*, 14(2), 274-289.
- Lentini, F. & Raimondo, F. M. (1984). Contribution à la connaissance du genre *Colchicum* L. en Sicile. *Webbia*, 38(1), 747-755.
- Nuki, G. (2008). Colchicine: its mechanism of action and efficacy in crystal-induced inflammation. *Current Rheumatology Reports*, 10(3), 218-227.
- Malo, S. & Shuka, L. (2013). Distribution of *Colchicum doerfleri* Halácsy, *Colchicum triphyllum* Kunze and *Colchicum bivonae* Guss., in Albania. *International Journal of Ecosystems and Ecology Science*, 3(2), 273-278.

- Mykhailenko, O., Ivanauskas, L., Bezruk, I., Marksa, M., Borodina, O. & Georgiyants, V. (2022). Effective and simple approach for colchicine determination in saffron parts. *Food Chemistry*, 368, 130862.
- Nualart, N., Ibáñez, N., Luque, P., Pedrol, J., Vilar, L. & Guàrdia, R. (2017). Dataset of herbarium specimens of threatened vascular plants in Catalonia. *PhytoKeys*, (77), 41.
- Quézel, P. & Santa, S. (1962). Nouvelle flore de l'Algérie et des régions désertiques méridionales. Paris, Editions du Centre National de la Recherche Scientifique.
- Richard, L. C. (1808). Démonstrations botaniques ou analyse du fruit considéré en général. Gabon, Librairie, Place de l'Ecole de Médecine, N°2. 111 p.
- Samaniego, N. M. & Velasco-Negueruela, A. (1984). "Colchicum triphyllum" en la provincia de Ciudad Real. *Anales del Jardín Botánico de Madrid*, 41 (2), 461.
- Senizza, B., Rocchetti, G., Okur, M. A., Zengin, G., Yıldıztugay, E., Ak, G., Montesano, D. & Lucini, L. (2020). Phytochemical profile and biological properties of *Colchicum triphyllum* (Meadow Saffron). *Foods*, 9(4), 457.
- Siddiqui, A. J., Jahan, S., Singh, R., Saxena, J., Ashraf, S.A., Khan, A., Choudhary, R. K., Balakrishnan, S., Badraoui, R., Bardakci, F. & Adnan, M. (2022). Plants in anticancer drug discovery: From molecular mechanism to chemoprevention. *BioMed Research International*, 18 p., ID 5425485.
- Terkeltaub, R. A., Furst, D. E., Bennett, K., Kook, K. A., Crockett, R. S. & Davis, M. W. (2010). High versus low dosing of oral colchicine for early acute gout flare: Twenty-four-hour outcome of the first multicenter, randomized, double-blind, placebo-controlled, parallel-group, dose-comparison colchicine study. *Arthritis & Rheumatology*, 62, 1060-1068.
- Toplan, G. G., Gurer, C. & Mat, A. (2016). Importance of Colchicum species in modern therapy and its significance in Turkey. *Journal of Faculty of Pharmacy*, 46, 129-144.
- Tutiempo (2023). Climate of Batna (Algeria) 2013-2022, Data provided by the weather station: 604680 (DABT) accessed via <https://fr.tutiempo.net/climat/ws-604680.html> on 2023-05-06
- Vinnersten, A. & Manning, J. (2007). A new classification of Colchicaceae. *Taxon*, 56, 171-178.
- Vinnersten, A. & Larsson, S. 2010. Colchicine is still a chemical marker for the expanded Colchicaceae. *Biochemical Systematics and Ecology*, 38, 1193-1198.