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A caryological, anatomical and histochemical investigation of *Athamanta cortiana* Ferrarini (Umbelliferae)

ANNA MARIA PAGNI

RÉSUMÉ

PAGNI, A. M. (1985). Investigation caryologique, anatomique et histochimique d'*Athamanta cortiana* Ferrarini (Umbelliferae). *Candollea* 40: 139-145. En anglais, résumé français.

Athamanta cortiana Ferrarini, endémique orophyte des Alpes Apuannes est analysé du point de vue caryologique, anatomique et histochimique. L'analyse caryologique montre que la plante est toujours diploïde ($2n = 22$). Les données anatomiques et histochimiques sont caractéristiques d'un hémicryptophyte typique du type xérique. Les canaux sécréteurs qui sont des structures produisant des substances pharmacologiques actives, sont abondants. Des commentaires sont ajoutés sur les organes de la plante les plus appropriés à un emploi pharmacologique.

ABSTRACT

PAGNI, A. M. (1985). A caryological, anatomical and histochemical investigation of *Athamanta cortiana* Ferrarini (Umbelliferae). *Candollea* 40: 139-145. In English, French abstract.

Athamanta cortiana Ferrarini, an endemic orophyte of the Apuan Alps, is analysed from the caryological, anatomical and histochemical points of view. Caryological analysis shows the plant as constantly diploid ($2n = 22$). Anatomical and histochemical data reveal the characteristics of a typical hemicryptophyte of the xeric type and a considerable abundance of secretory canals, which are the structures for the production of pharmacologically active substances. Some considerations are made regarding the most suitable parts of the plant for pharmacological purposes.

Introduction

This report on *Athamanta cortiana* (FERRARINI, 1965), an endemic orophyte of the Apuan Alps (north-western Tuscany), apparently never studied until now, is part of a research project on the Italian Umbelliferae as a possible source of flavonoids and coumarins (CORSI & PAGNI, 1983; CORSI & al., 1984).¹

The investigation concerns caryological, histochemical and anatomical aspects and aims at gathering useful information both as to the significance of this endemism and on the parts of the plant which produce the above-mentioned substances.

Materials and method

Plants for analysis were gathered in the wild at 1200 m from Pizzo delle Saette, Apuan Alps, then cultivated in the Orto Botanico, Pisa University. For the caryological analysis root apices coloured by the normal Heitz method were used and sections of 20-30 μm thickness for the histochemical and anatomical analyses. They were coloured with Azure B, methylene blue and iron haematoxylin to distinguish the structure, and with Delafield's haematoxylin and ruthenium red for the mucilage (FAURE, 1914; JENSEN, 1962). Phloroglucinol was used to show lignin (JENSEN, 1962), Sudan III for lipophilic substances and Sudan III with glacial acetic acid for the essential oils (FAURE, 1914). Dried specimens of the plants examined are deposited in PI.

¹This project was carried out with a contribution from the Italian Ministry of Public Instruction, Inter-University project "Risorse farmacobotaniche della flora italiana con particolare riguardo alle entità endemiche: 1. indagine: le Ombrellifere come fonte di flavonoidi e cumarine".

Caryological observations

A. cortiana is a diploid, with a chromosomal formula of $2n = 22 = 6M + 14m + 2m$ using symbols defined by LEVAN & al. (1964). The chromosomes are medium to small in size (from 2.5 μm to 4 μm). One pair is satellited (Fig. 1).

Anatomical observations

The root

The primary structure (Fig. 2) of the root presents a variable number of arches: diarch, triarch and tetrarch roots were seen. In all cases there was precocious development of the metaxylem which is differentiated from the centre of the stele. The endodermis presents casparian thickenings.

In the cortical parenchyma numerous secretory canals of roundish section are present. There are surrounded by only one layer of non-thickened pectic-cellulose walled cells and cytoplasm of a high lipophilic content.

Sections taken from the secondary structures (Fig. 3) reveal a cortex of spongy appearance with numerous intercellular spaces, a very thick peripheral suberized layer and abundant vascular tissue through which pass rays of a considerable size. A large number of secretory canals, identical to those described for the primary structure, are found both in the cortical parenchyma and in the phloem.

The stem

The cross-section of the stem (Fig. 4) is circular and reveals numerous collenchymatic ribs. The epidermis is one-layered and considerably cutinized with numerous one-celled hairs and infrequent stomata.

The cortical parenchyma, consisting of only a few layers of cells, presents secretory canals in association with vascular bundles which are analogous in structure to those observed in the root. The vascular tissue consists of collateral bundles arranged in a ring in varying number according to the size of the stem.

There is precocious secondary growth, with a predominance of mechanical fibres. The pith consists of large polyhedral cells. In adult stems, the most internal part of the pith is broken-down and the cell walls in the parenchyma surrounding the bundles are sclerified and this strengthens the stem.

The leaf

The cross-section at the level of the rachis (Fig. 5) shows numerous ribs formed from angular collenchyma, opposite which the vascular bundles are found. There are 7-9 of them in the main rachis, depending on its size; the number decreases towards the distal ribs.

The bundles are surrounded by one or two layers of parenchymatic cells with gelatinized walls, probably involved in transport.

The bundles are always found in association with a secretory canal, analogous in structure to those observed in the other vegetative parts.

The parenchyma is well sclerified around the bundles.

The epidermis has the same features as those observed elsewhere; hairs are numerous and the stomata are evenly distributed over the whole surface.

The cross-section of the leaf lamina (Fig. 6) at the level of the last segment is elliptic and slightly concave on the adaxial side.

The mesophyll is compact; 3 vascular bundles, surrounded by a many-layered parenchymatic sheath, in a similar way to the rachis bundles, pass through it. Stomata are few and found over the whole surface.

The fruit

This is roughly 1.4 mm wide and 7 mm in length, similar in shape to that described for many other Umbellifers (MOYNIER DE VILLEPOIX, 1878; TANFANI, 1891). It has a fairly flat commissural face, dorsally it is convex, with 5 not very prominent ribs, each corresponding to a vascular bundle (Fig. 7).



Fig. 1. — *A. cortiana*: caryotype.

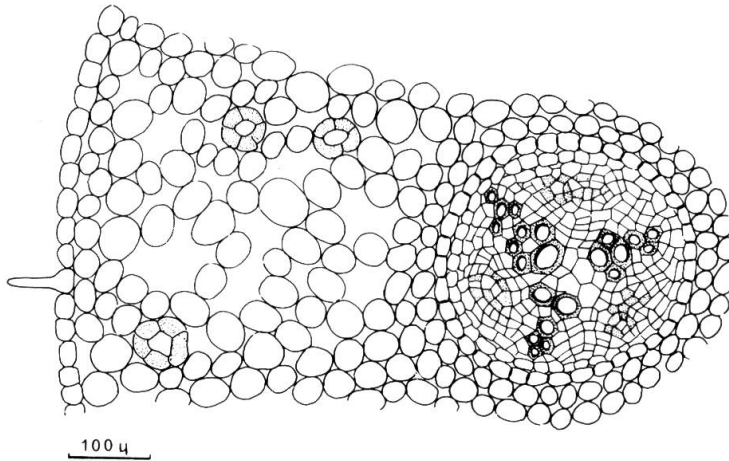


Fig. 2. — Cross-section of primary structure of *A. cortiana* root.

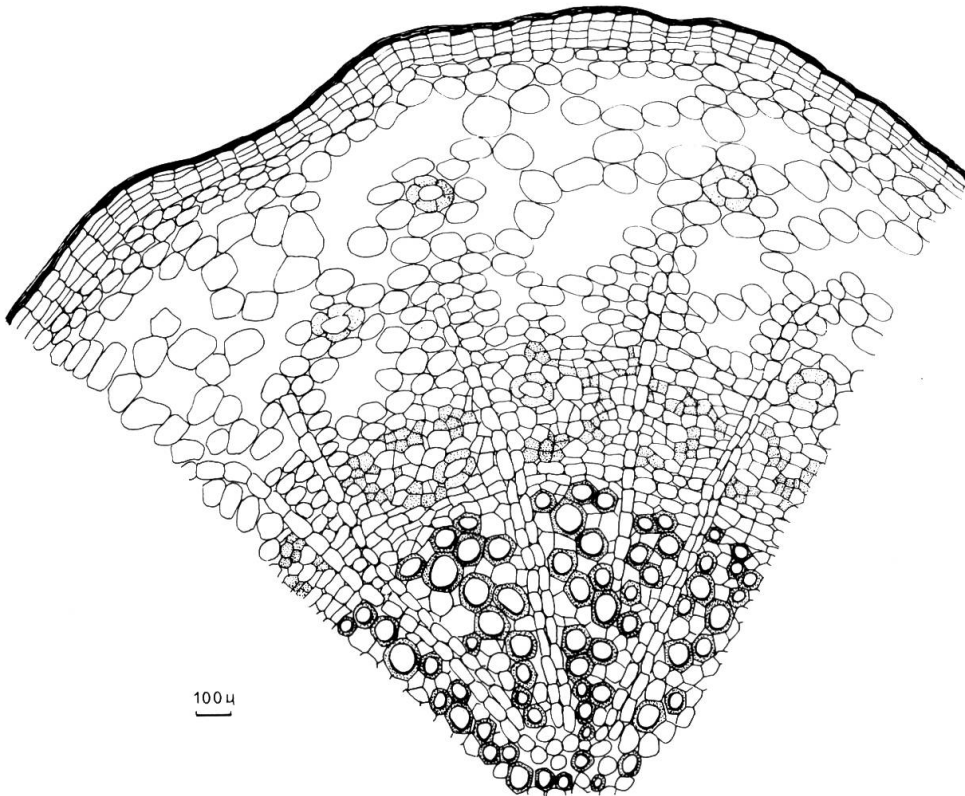


Fig. 3. — Cross-section of secondary structure of *A. cortiana* root.

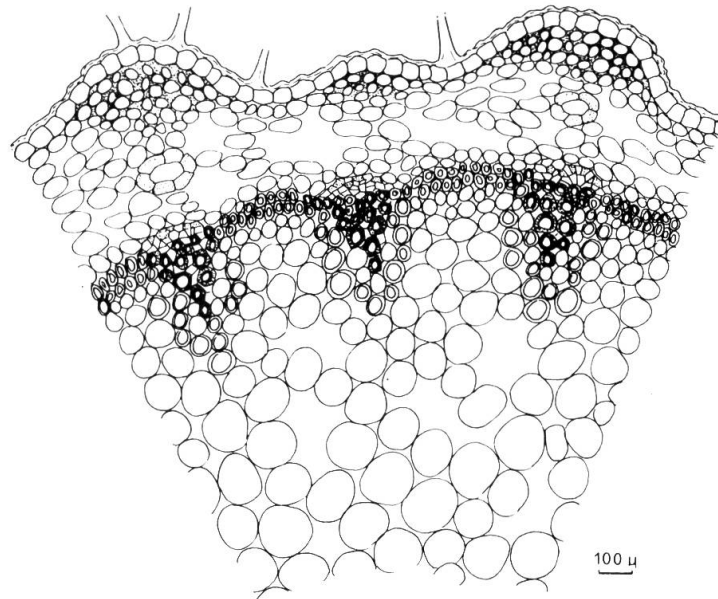


Fig. 4. — *A. cortiana*: cross-section of stem.

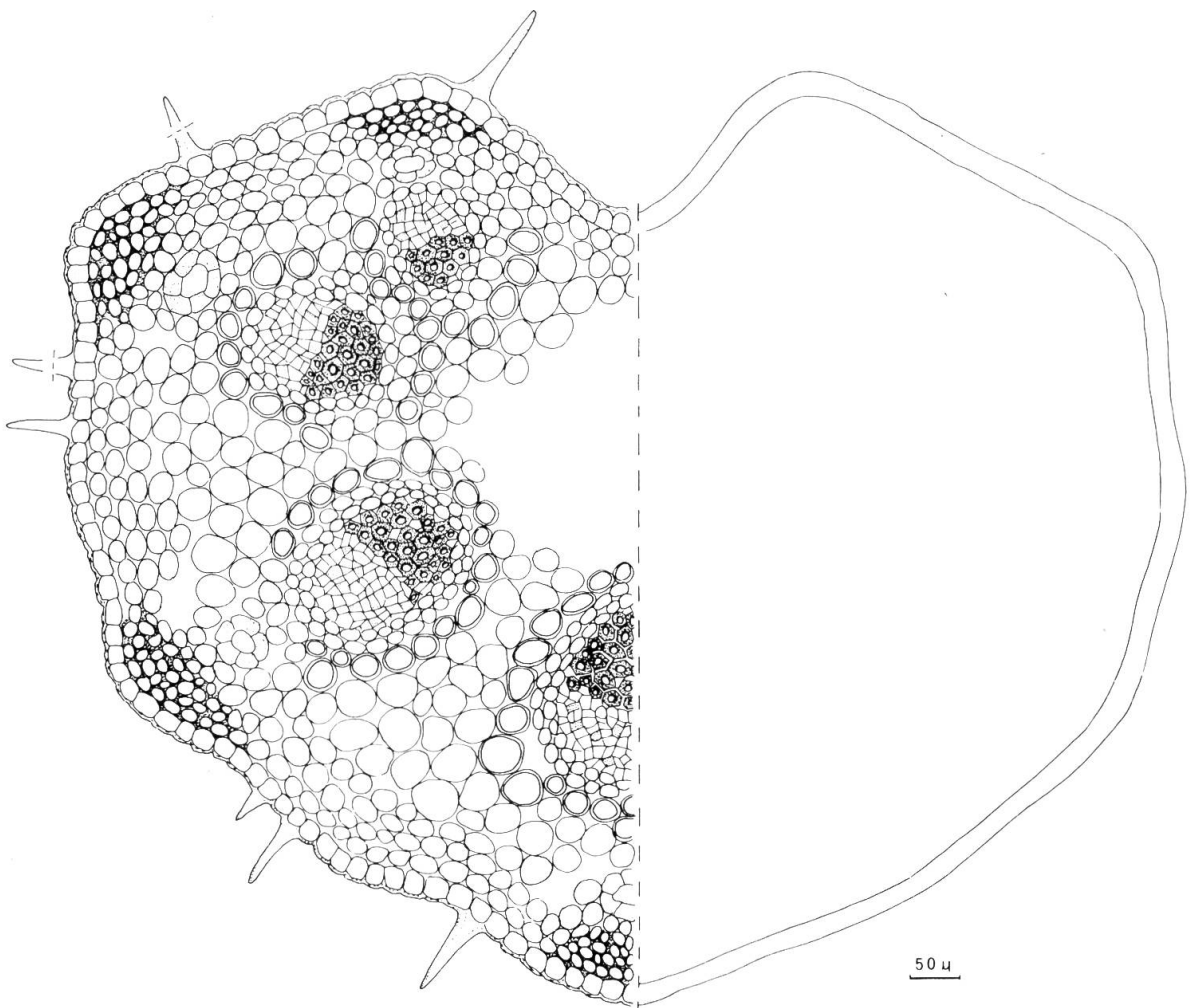


Fig. 5. — *A. cortiana*: cross-section of rachis.

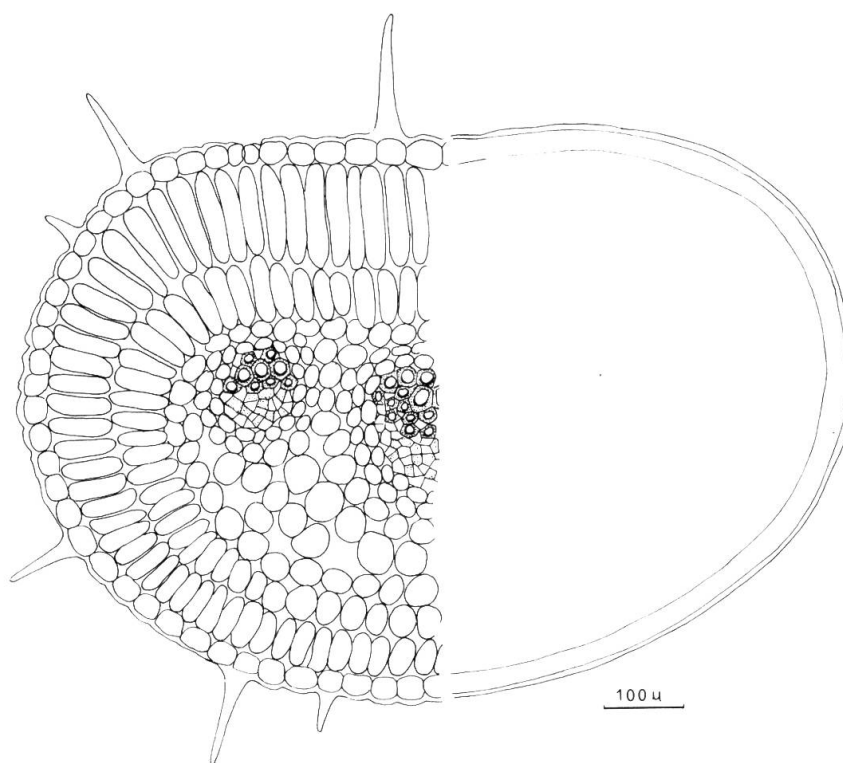


Fig. 6. — *A. cortiana*: cross-section of the leaf lamina (final segment).

The epicarp consists of a layer of strongly cutinized cells covered by abundant hairs.

The mesocarp consists of a few layers of parenchymatic cells, and the endocarp of one layer of tangentially elongated cells, with walls slightly lignified corresponding to the commissural face.

At the level of each vallecule there are from 1-3 vittae with a lenticular lumen (the literature defines "vittae" as the secretory canals present in the achene). Where there is only 1 vitta there are sometimes 2 smaller vittae above them, with a round lumen. The vittae are surrounded by a layer of cells with a thickened, probably suberized tangential internal wall. At the level of each rib, at each side of the bundle, there are sometimes 1-2 smaller vittae with a round lumen, and externally to the bundle itself, 1-2 small secretory canals, morphologically identical to those present in the vegetative organs.

The seed is surrounded by a single tegument, one-layered and composed of cells containing lipophilic matter; corresponding to the commissural side this layer differentiates a well-developed parenchymatic mass, through which the raphe passes. The endosperm, which is cellularized, contains lipophilic matter and starch grains.

Discussion and conclusions

All the samples of *A. cortiana* examined proved to be diploids, as are other species of the genus already examined (WANSCHER, 1931; FAVARGER, 1959, 1965; SUSNIK, 1967; PARRAUX, 1971; RAIMONDO & GARBARI, 1975; LEUTE, 1977; CHICCHIRICCO' & TAMMARO, 1980).

The anatomical features (strongly cutinized epidermis, few stomata, abundant mechanical tissue, compact leaf mesophyll etc.) are those of a xeric hemicryptophyte.

It seems that *A. cortiana* is a paleogenic endemism, as suggested by previous authors (FERRARINI, 1967; GARBARI, 1970; PIGNATTI, 1982). This is however a question to be further investigated.

Concerning which parts of the plant are most suitable for the extraction of active principles (those, that is, richest in secretory canals, where these active principles are nearly always produced (CROWDEN & al., 1969; HEGNAUER, 1971; FAHN, 1979) something more is to be said. Mor-

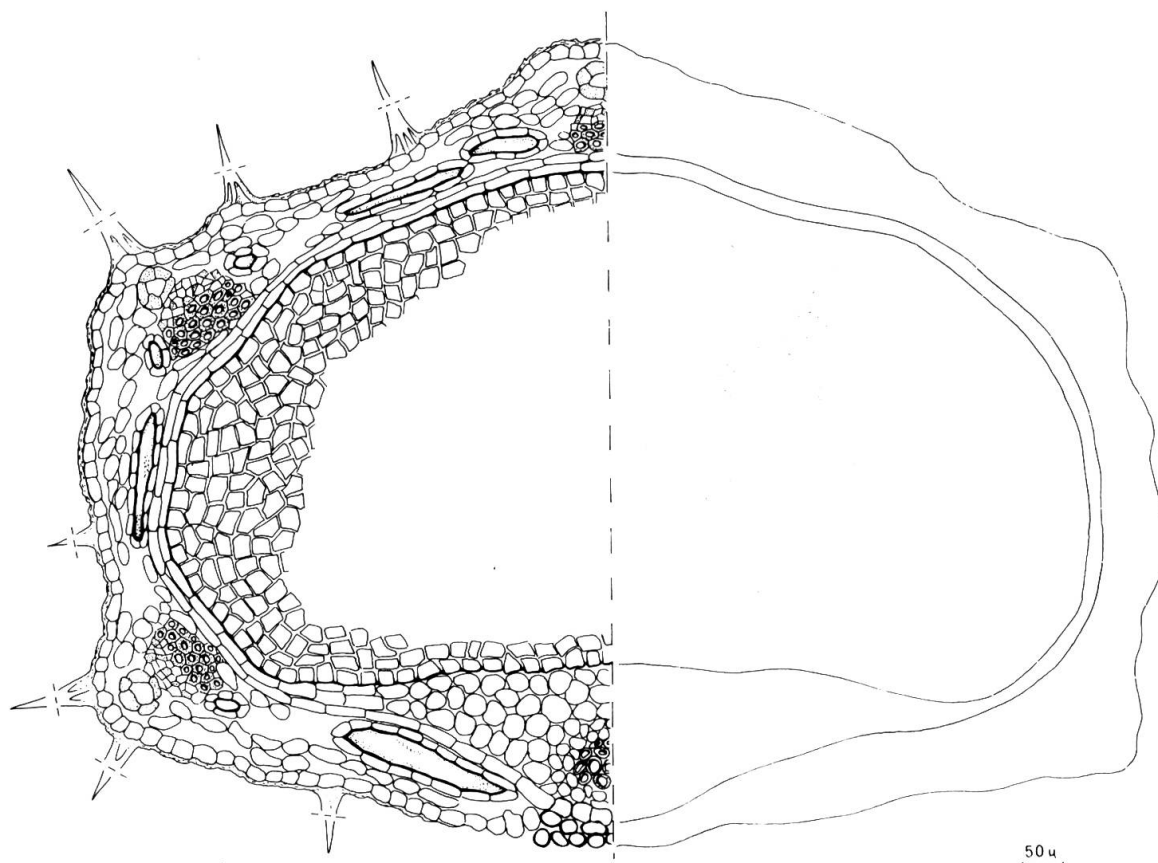


Fig. 7. — *A. cortiana*: cross-section of fruit.

phologically and histochemically the secretory canals are of two types: *a*) the vittae, which are only present in the fruit and *b*) the secretory canals, present in the vegetative organs, in particular in the root. Analyses at present being undertaken will define the chemical characteristics of both types of secretory canals, making it possible to define which are the most suitable parts for use in pharmacology.

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Mosses from Northern Part of Jordan

A. A. EL-OQLAH

&

J. N. LAHHAM

RÉSUMÉ

EL-OQLAH, A. A. & J. N. LAHHAM (1985). Mousses du Nord de la Jordanie. *Candollea* 40: 147-152. En anglais, résumé français.

Les auteurs énumèrent 25 espèces de mousses récoltées dans le Nord de la Jordanie en 1982 et 1983. Des notes sur l'écologie, la géologie et la végétation de la région sont jointes à cette énumération.

ABSTRACT

EL-OQLAH, A. A. & J. N. LAHHAM (1985). Mosses from the Northern Part of Jordan. *Candollea* 40: 147-152. In English, French abstract.

The authors enumerate 25 moss species collected from the northern part of Jordan in the years 1982 and 1983. Notes on the ecology, geology and vegetation of the area are added.

Introduction

This study is based on collections made during 1982 and 1983 year from the northern part of Jordan. The area covered in this study is located in the East Bank of Jordan forming the Northern part of Transjordan plateau and Ghor (Map 1).

The area studied falls within the Mediterranean bioclimate characterised by prolonged dry and hot summers with rainfall occurring mostly in winter. The area shows a considerable variation in climatic conditions especially in annual rainfall. The northern, northwestern, and southern parts of region receives more than 500 mm average annual rainfall. This gradually drops to about 150 mm at Mafraq, just a few kilometers to the east. Fluctuations in the annual rainfall from year to year are very pronounced and in some dry winters it falls far below the critical point for plant growth even in the high rainfall areas. Mean annual temperature of the area studied ranges between 15°-20°C. The coldest month is January with a mean temperature of 3°-5°C. Snowfalls are a regular winter feature. The hottest month is July with mean temperatures of 32.0°C.

The area embraces marine sediments of approximately Cenomanian and Turonian age as defined by QUENNELL (1951). In the main, they are limestones, sometimes dolomitic with some interbedded marls; shales, sandstones and chalks occur rarely.

Although the area is covered by evergreen maquis, only about half the number of its tree species are evergreens. These are *Quercus calliprinos* Webb., *Pistacia lentiscus* L., *Arbutus andrachne* L., *Ceratonia siliqua* L., *Phillyrea media* L., *Rhamnus alaternus* and others. Of the conifers *Pinus halepensis* Bieb. is very common while *Cupressus semipervirens* L. is rare or confined to isolated spots only.

Among the winter deciduous species are *Quercus aegilops* L., *Q. infectoria* Oliv., *Pistacia terebinthus* L. subsp. *palaestina* Engl., *Styrax officinalis* L., *Cercis siliquastrum* L. and *Crataegus azarolus* L.

The specimens of mosses collected by the authors are deposited at the herbarium of Yarmouk University. The species are arranged alphabetically after their related genera and families.

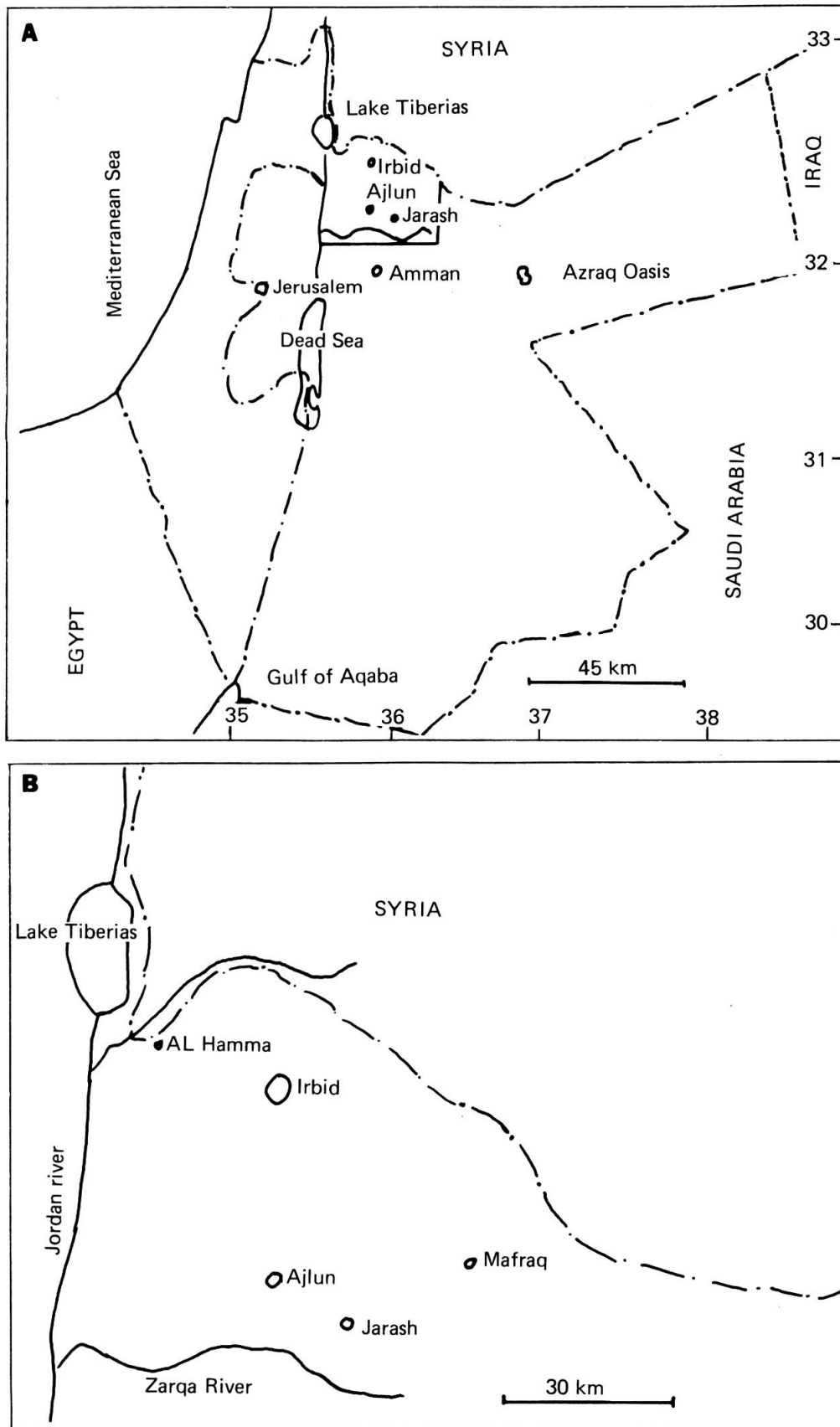


Fig. 1 — **A**, map of the collection area (cross hatching) in relation to Jordan and the surrounding countries; **B**, detail of the area in which the collections were made.

List of Musci according to the Familia

Brachytheciaceae

Camptothecium aureum (Spruce) B.S.G.

- Ajlun: Rasoun, Sous Rasoun; alt. 800 m. On tree trunk. El-Oqlah, Lahham and Khudair, 30 March 1983.
 Irbid: Zobya, Birgish Forest; alt. 850 m. On trunks of oak trees. El-Oqlah, Lahham and Khudair, 8 May 1983.

Rhynchostegiella tenella (Dicks) Limpr.

- Ajlun: Rasoun, Sous Rasoun; alt. 850 m. On rocks, in very shady place. El-Oqlah, Lahham and Khudair, 30 March 1983

Scleropodium touretii (Brid) L. Koch.

- Irbid: Dair Abu-Said, Wadi Elrayan; alt. 200 m. On tree trunks. El-Oqlah, Lahham and Khudair, 11 December 1982

Scorpiurium circinatum (Brid.) Fleisch. & Loeske

- Irbid: Zobya, Birgish Forest; alt. 800 m. Under forest, in a shady and wet aerea. El-Oqlah, Lahham and Khudair, 8 May 1983.

Bryaceae

Bryum bicolor Dicks.

- Ajlun: Eshtafehna; alt. 1100 m. On wet aerea. El-Oqlah and Khudair, 15 April 1983.
 Jarash: Ain El Deek; alt. 500 m. In a shady and wet place. El-Oqlah, Lahham and Khudair, 10 April 1983.

Bryum caespiticum Hedw.

- Ajlun: Rasoun, Sous Rasoun, alt. 800 m. On rotten tree trunk. El-Oqlah, Lahham and Khudair, 30 March 1983.
 Ajlun: Anjara; alt. 1200 m. On limestone rocks. El-Oqlah, 19 March 1983.
 Ajlun: Ajlun Forest; alt. 1000 m. El-Oqlah, Lahham and Khudair, 10 April 1983.
 Irbid: Banikanana, Agraba; alt. 100 m. On limestone rocks, in a shady and wet place facing north. El-Oqlah and Khudair, 3 April 1983.

Bryum capillare Hedw.

- Irbid: Zobya; alt. 850 m. Beneath rocks, in shady and wet aereas. El-Oqlah, Lahham and Khudair, 4 April 1983.

Encalyptaceae

Encalypta vulgaris Hedw.

- Ajlun: Eshtafehna Forest; alt. 1200 m. On rocks under forest. El-Oqlah and Lahham, 15 Avril 1983.

Fabroniaceae

Fabronica pusilla Raddi

- Ajlun: Rasoun, Sous Rasoun; alt. 800 m. On oak tree trunks. El-Oqlah, Lahham and Khudair, 30 March 1983.

*Fissidentaceae***Fissidens bryoides** Hedw.

- Jarash: Ain Jamla; alt. 650 m. On rocks, along a stream, in a shady place facing north. El-Oqlah, Lahham and Khudair, 10 April 1983.

*Funariaceae***Funaria attenuata** (Dicks.) Lindb.

El-Ghor El-Shamaly, El-Zumaliyeh, Tabkat Fahl; alt. 200 m. On rocks, along a stream, in a shady and wet place. El-Oqlah and Khudair, 19 March 1983.

Ermamean; El-Shalaleh; alt. 500 m. In cliff, in a shady and very wet place. El-Oqlah, Lahham and Khudair, 20 avril 1983.

- Jarash: Ain El-Deek; alt. 500 m. On an irrigation canal. El-Oqlah, Lahham and Khudair, 10 April 1983.

Funaria hygrometrica Hedw.

- Irbid: Zobyia; alt. 850 m. On terra-rossa soil, in shady and wet place. El-Oqlah, 1 January 1983.

- Irbid: Banikanana, Abu El Lougas, Ain Elabdèh alt. 600 m. On rocks and a stream wall. Khudair, 4 may 1983.

Funaria pulchella Philib.

- Ajlun: Ajlun Forest; alt. 1000 m. On rocks and tree trunks. El-Oqlah, Lahham and Khudair, 30 march 1983.

*Grimmiaceae***Grimmia pulvinata** (Hedw.) Sm.

- Irbid: Zobyia; 850 m. On limestone and volcanic rocks. El-Oqlah, 10 February 1983.

*Orthotrichaceae***Orthotrichum cupulatum** Brid.

- Ajlun: Rasoun, Sous Rasoun; alt. 800 m. Under forest on tree truncks. El-Oqlah, Lahham and Khudair, 30 April 1983.

- Irbid: Zobyia; Birgish Forest; alt. 800 m. On oak tree truncks. El-Oqlah, Lahham and Khudair, 8 May 1983.

*Pottiaceae***Barbula lurida** (Hornsch.) Lindb.

- Alalouk: Alt. 650 m. On rocks along a stream. El-Oqlah, Lahham and Khudair, 23 March 1983.

- Ajlun: Rasoun, Sous Rasoun; alt. 850 m. Under forest on tree truncks. El-Oqlah, Lahham and Khudair, 30 march 1983.

- Jarash: Jarash ruins; alt. 500 m. Lahham, 19 March 1983.

Barbula vinealis Brid.

- Jarash: Ain El Deek; alt. 500 m. In a shady and wet place. El-Oqlah, Lahham and Khudair, 10 April 1983.

Eucladium verticillatum (Brid.) B.S.G.

- Jarash: King Talal Dam; alt. 200 m. On limestone rocks. El-Oqlah, Lahham and Khudair, 10 April 1983.

Gymnostomum calcareum Nees & Hornsch.

Ermamean: Elshalaleh; alt. 500 m. On rocks, in shade and very wet place. El-Oqlah, Lahham and Khudair, 24 April 1983.

Timmiella barbuloides (Brid.) Moenk.

- Ajlun: Rasoun, Sous Rasoun; alt. 800 m. On limestone rocks. El-Oqlah, Lahham and Khudair, 30 March 1983.
 El Ghor El Shamaly: Elzumalyeh, Al Jerim Nursery; alt. 200 m. On an irrigation canal wall. El-Oqlah and Lahham, 10 April 1983.
 Jarash: Dibben National park; alt. 800 m. On rocks, under pine trees. El-Oqlah, Lahham and Khudair, 10 April 1983.
 Jarash: King Talal Dam; alt. 200 m. On limestone rocks, in a shady and wet place. El-Oqlah, Lahham and Khudair, 10 April 1983.

Tortula inermis (Brid.) Mont.

- Irbid: Zobyia; alt. 850 m. On terra-rossa soil, beneath rocks. El-Oqlah, 1 February 1983.
 Irbid: Zobyia; alt. 850 m. On rocks, in a shady place. El-Oqlah, 1 February 1983.

Tortula muralis Hedw.

- Irbid: Dair Abu Said; Ejdata; Wadi Al-Rayan; alt. 150 m. On rocks, along an irrigation canal. El-Oqlah and Lahham, 8 May 1983.
 Jarash: Ain El Deek; alt. 600 m. On a irrigation canal wall. El-Oqlah, Lahham and Khudair, 8 May 1983.

Tortula ruralis (Hedw.) G.M.S

- Ajlun: Rasoun, Sous Rasoun; alt. 800 m. On rotted tree trunks, under oak forest trees. El-Oqlah, Lahham and Khudair, 30 March 1983.

Pterygoneurum ovatum (Hedw.) Dix.

- Irbid: Zobyia; alt. 850 m. On terra-rossa soil, beneath rocks. El-Oqlah, 10 February 1983.

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The authors wish to express their sincere thanks and gratitude to Mr. Ian Iddy, the British Natural History Museum, for his help in identifying some of our specimens. Mr. Mohammad Khudair, Yarmouk University, was of great help to us in collecting, and storing our plant specimens. The research grants offered by the Jordanian National Planning Council and Yarmouk University are very much appreciated.

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