

**MORPHOLOGICAL, ANATOMICAL AND CYTOLOGICAL
CHARACTERISTICS OF ENDEMIC *LILIUM CILIATUM*
P.H. DAVIS (*LILIACEAE*) IN TURKEY**

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Abstract

Morphological, anatomical and cytological characteristics of endemic *Lilium ciliatum* P.H. Davis (*Liliaceae*) were investigated. Colour of flower with a brown centre and finely spotted in upper part of flower are characteristics for *Lilium ciliatum*. Cross sections of *Lilium ciliatum* root, stem, bulb, leaf and flower parts were examined division has been used for cytological studies. Counting the metaphase chromosomes at the root tips, the chromosome number of the *Lilium ciliatum* was found to be $2n=24$.

Introduction

Lilium has 100 species and is found in temperate north region of the world (Seçmen *et al.*, 1995). In Turkey it is represented by 6 species (Davis 1984) where *Lilium ciliatum* P.H. Davis is endemic. Species of *Lilium* are bulbous and perennial. Many species of the Liliaceae family are grown in parks and gardens as ornamental plants due to its beautiful flower (Karamanoğlu, 1973). Some of the species of *Lilium* are aromatic and are used in perfumery industry (Güney 1989). Some *Lilium* species, which have effective substance, are used in the preparation of drugs for the treatment of skin disease, abscess, pimple (Baytop 1984). In addition, some species of the *Lilium* are used as adhesive and paint (Özçelik *et al.*, 1990). *Lilium ciliatum* is also exported for Turkey (Koyuncu 1986; Ekim *et al.*, 1991).

Materials and Methods

Plant samples were collected from natural population between 1998-1999. Specimens were preserved in the herbarium at Ondokuz Mayıs University Faculty of Art and Science, Department of Biology. Samples were collected from A7 Trabzon (Çarşıbaşı-Zeytinlik district) forest on 12.7.1998 (Özdemir 037) and A7 Trabzon (Hamsiköy-Bekçiler district) forest on 18.7.1999 (Özdemir 038) Taxonomic description of the plants was made according to Davis (1984). Fresh samples were used in each case for experimental analysis and measurements. Anatomical work was carried out using fresh samples tissue shored in alcohol and Paraffin infiltrated tissues (Algan 1981). Cross section of root, stem, bulb, leaves, and flowers were cut. Squash techniques (Elçi, 1982) were used for cytological analysis.

Results

Morphological properties

The root is 2–8 cm in length and 0.2–0.8 cm wide. Dark-brown bark is present on the root (Fig. 1A, B). The perennial herbaceous stem is 50–160 cm tall and erect. Surface of stem is covered by light green glandular hair, (Fig. 1A, B).

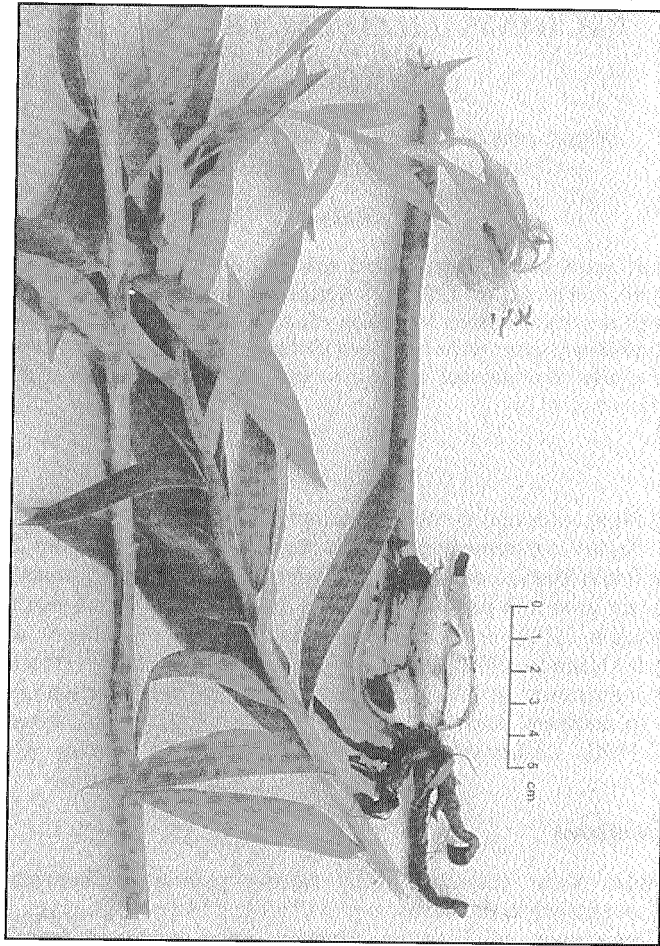


Fig. 1A. General appearance of *Lilium ciliatum* (Özdemir 037).

Leaves are 2–14 cm x 0.5–2 cm, lanceolate to linear-lanceolate and spirally arranged on stem. The venation of leaves is parallelodrom (Fig. 1 A, B).

The flower is pale sulphur in colour, centre and finely spotted in upper part with 6 perianth segments which are narrowly elliptic-oblong and recurved in shape, 4–5.5 x 1–2 cm. The filament is free with anthers 0.3–0.8 cm, light-brown in colour and style 1–2 cm (Fig. 1A, B).

Bulb 3–5 cm long, 4.5–8 cm in diameter with elongate bulb scales. It has not a tunic (Fig. 1 A, B).

Species distributed at 1500–2400 m height, margins of forests and in clearings scrub, rich meadows above tree line.

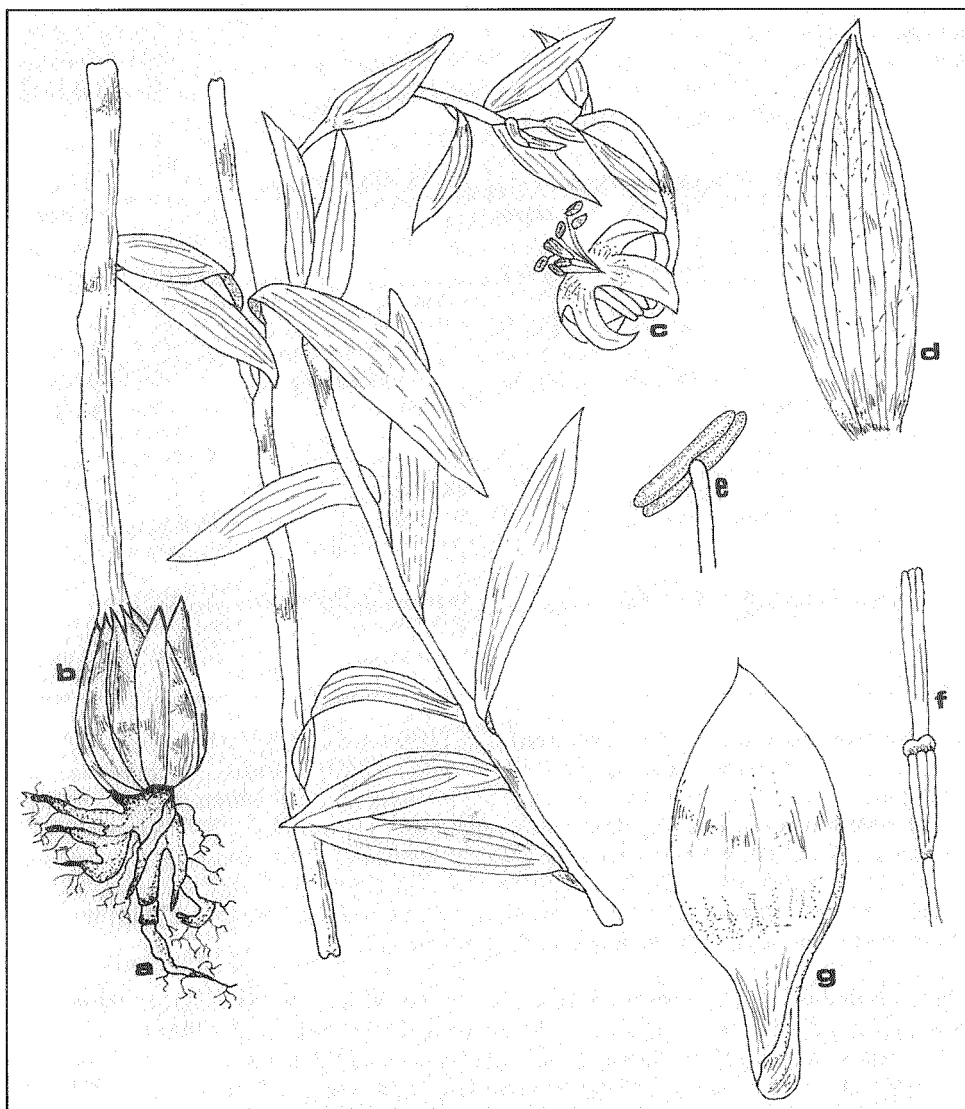


Fig. 1B. General appearance of *Lilium ciliatum* (Özdemir 037)

a- root; b- bulb; c- flower; d- leaf; e- stamen; f- pistil; g- tepal;
 a, b, c: X 1.6; d: X 1.7; e: X 0.2; f: X 0.3; g: X 0.7

Anatomical properties

Root: Epidermis single layered on the outer surface of root, 15–45 x 18–40 μ with aglandular hairs on cells of epidermis (Table 1). Cells of cortex ovoid, parenchymatic with intercellular spaces. Endodermal cells 10–35 x 15–43 μ with wall thickenings of the

endodermal clear in cross – section. Primary vascular tissue is surrounded by the pericycle which is single layered with thick-walled, small cells 18–40 x 10–20 μ . There are 8–12 metaxylem on the part median of vascular cylinder. Xylem strands on the periphery of the vascular cylinder are 8–10 which reach the pericycle. Phloem is very small and is located between two xylem strands. The pith of vascular cylinder is sclerenchymatous (Fig. 2).

Table 1. Measurements of various tissue of *Lilium ciliatum* .

	Broad		Length		Broad		Length	
	(μ)		(μ)		(μ)		(μ)	
	min	max	min	max	min	max	min	max
ROOT								
Epidermis cell	15	45	18	40				
Endodermis cell	10	35	15	43				
Parenchyma cell	18	40	10	20				
Metaksilem diameter	28	95						
Protoksilem diameter	5	15						
Diameter of pith cell	8	18						
STEM								
Epidermis cell	10	55	13	43				
Diameter of sclerenchyma	12	88						
Diameter of cortex cell	23	103						
Diameter of tracheal elements								
Diameter of parenchyma cell	5	35						
LEAF								
Cuticle					2	3		
Upper epidermis cell	8	30					3	20
Lower epidermis cell	5	20					18	30
Mesophyll cell	18	25					45	50
BULB								
Epidermis cell					23	63	25	125
Diameter of phloem					7	27		
Diameter of tracheal elements					8	25		
Diameter of parenchyma cell					3	120		

Stem: Epidermis single layered and consist of cubical cell 10–55 x 13–43 μ (Table 1). Stoma cells are infrequent and are present among the epidermis cells. Cuticle is thick, on outer part of epidermal cells. There are the capitate glandular hair which has head cells on the stem with no stalk cells. Cortex cells located under epidermis are 5–6 layered 23–103 μ in diam., with intercellular spaces. There are a sclerenchymatous ring under cortex 3–5 layered, cell diameter of 12–88 μ . These cells of sclerenchyma surround the vascular bundles of stem. Vascular cylinder consist of thick-walled and parenchymatous cells which are bigger in pith region than other regions (Fig. 3).

Leaf: Epidermis single layered on upper and lower surface of leaf. Cuticle present on both upper and lower epidermis. Cells of lower epidermis 5–20 x 12–25 μ and of upper epidermis 8–30 x 3–20 μ (Table 1). It is difficult to distinguish the cells of palisade parenchyma with the cells of spongy parenchyma on mesophyll of leaf. Mesophyll cells 18–25 x 45–50 μ are more or less uniform in shape. Large lobes are present on the mesophyll cells which therefore appear brached. Some of the mesophyll cells are leaning to one side. Stoma cells are present only on lower epidermis. These cells are not associated with any subsidiary cells. Stoma cells are located below the level of epidermal cells. The vascular bundles different in size and are single layered are present on median part of mesophyll. The walls of upper and lower epidermis cells are clear sinuous in surface sections of leaf. Lower epidermis has stoma cells whereas the upper epidermis has no stoma cells. There are capitate glandular hairs, which have head cells on the leaves. There are 1–2 central cells in different numbers at these capitate hairs. But these capitate glandular hairs do not have any stalk cells (Fig. 4, 5).

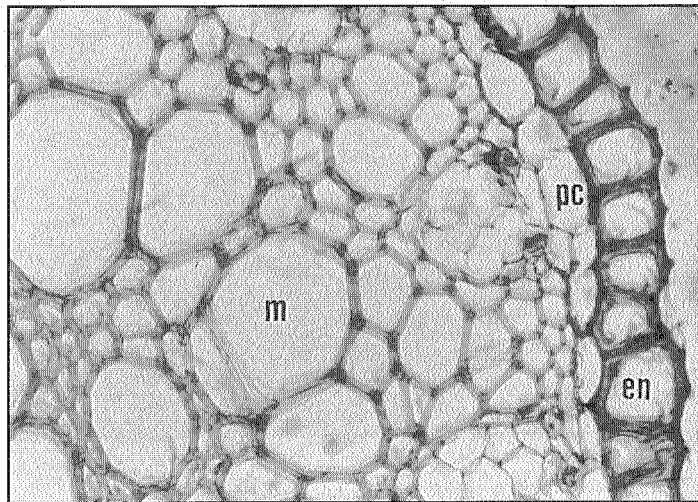
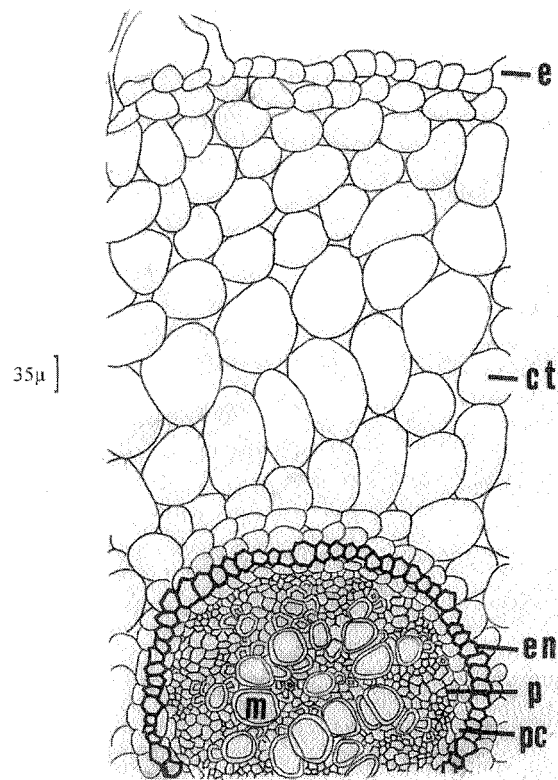


Fig. 2. Cross-section of root of *Lilium ciliatum* (Özdemir 037)
e- epidermis; ct- cortex ; en- endodermis ; pc- pericycle ; p- phloem; m- metaxylem.

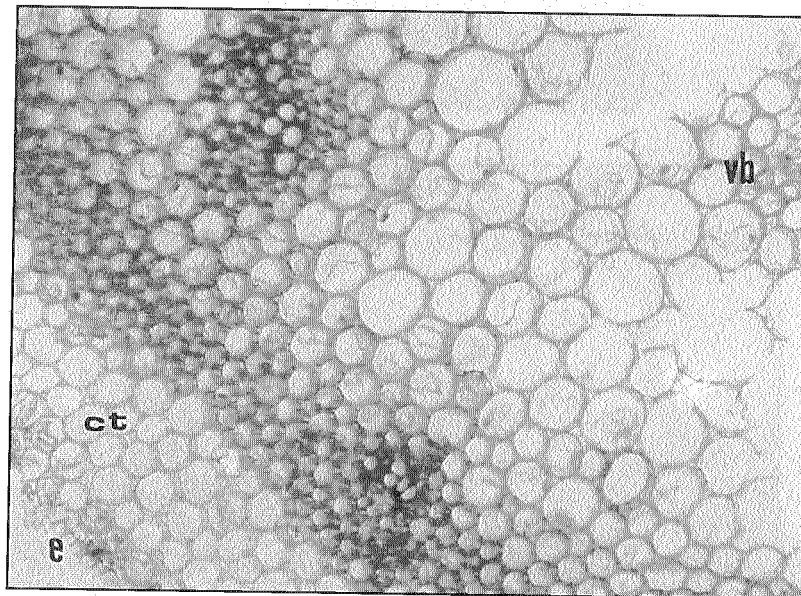
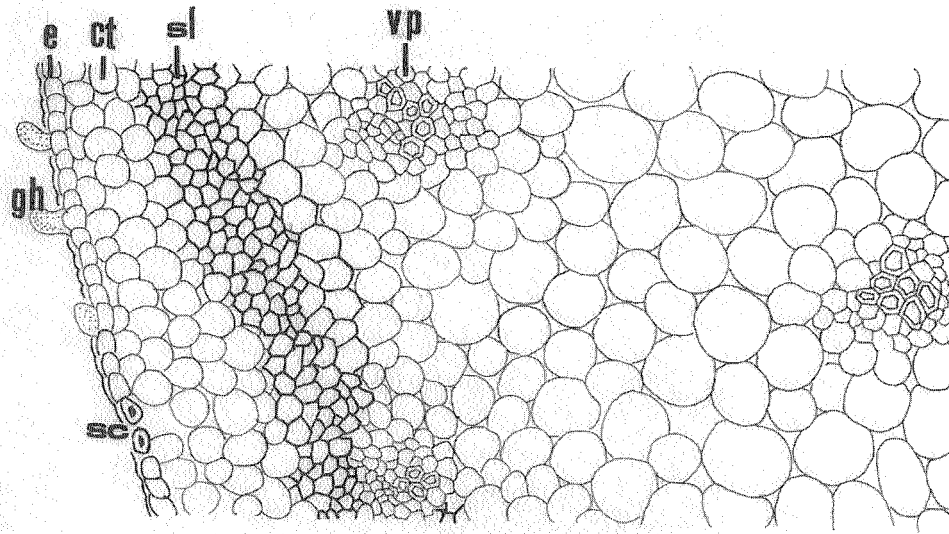


Fig. 3. Cross-section of stem of *Lilium ciliatum* (Özdemir 037) X 400
 e- epidermis; sc- stoma cell; gh- glandular hair; sl- sclerenchyma;
 ct- cortex parenchyma; vb- vascular bundle; Sc- Stomata.

Bulb: Epidermis is single layered with long cells 23–63 x 25–125 μ (Table 1). Cortex is multilayered and parenchymatic with cells hexagonal or ovoidal 3–120 μ . There are a lot of starch grains in parenchymatic cells. The vascular bundles are located as scattered in cortex. Xylem elements have larger region than phloem elements (Fig. 6).

Flower: Cross section of the tepal show that both the inner and the outer epidermis are formed of cells with nearly the same height and width. Cuticle is present on these cells. Stoma cells are located among to epidermis cells. There are mesophyll between the inner and the outer epidermis. Cells of mesophyll parenchymatic and are ovoidal in shape. The vascular bundles single layered and are present on median region of mesophyll. (Fig. 7).

Cytological properties

Somatic chromosome numbers of *Lilium ciliatum* were counted as $2n=24$. Two pairs of the chromosomes are relatively short-cylindrical, the remaining 20 pairs are long- virgate (Figs. 8, 9).

Discussion

In this study morphological, anatomical and cytological characteristics of endemic *Lilium ciliatum* were studied.

It was determined that morphological characters such as shape and colour of perianth for of venation of leaf have taxonomical value. Properties of glandular hairs and perianth segment of taxon is coloured as pale sulphur, with a brown centre and finely spotted in upper part. These features of *Lilium ciliatum* are distinct from other species of *Lilium*. In the present study the length of stem, anther and leaf were determined respectively as 50-160 cm, 0,3-0,8 cm and 2-14 cm while in Flora of Turkey these measurements respectively are 60-140 cm, 0,6-0,8 cm and 7-13 cm.

In anatomical studies it has been determined that root of taxon is typical as monocotyledons root. The cortex is rather large in cross-section as observed in the roots of *Pancratum maritimum* L., and *Leucojum aestivum* L., (Kılınç & Yüksel 1995; Kutbay *et al.*, 1993). The thickening are clear on the walls of the endodermal cells. It has been emphasized that this type of endodermal cells are common in the roots of monocotyledons (Fahn, 1982). Root of *Lilium ciliatum* has not a pith which is then occupied by metaxylem. The number of protoxylem groups are 8-10 in the root. So this protoxylem groups is said to be polyarc (Fahn, 1982). There are sclerenchymatic ring among the cortex of stem. The same sclerenchymatic ring on the stem of *Gagea bulbifera* (Pall.). Roem. Et Schult., *Fritillaria erzurumica* Kasaplıgil and *Gladiolus atroviolaceus* has been reported (Özyurt, 1987).

The palisade and spongy cells are not distinguishable in the leaf of *Leucojum aestivum* (Kutbay *et al.*, 1993). In the present study we found the same characteristics. Fahn (1982) pointed out that the guard cells are not associated with any subsidiary cells. This type can be seen in any species of the liliales as also observed in the present study. Researchers has emphasized that the large lobes are present on the palisade which therefore appear branched, but we observed this characteristics on different parts of mesophyll.

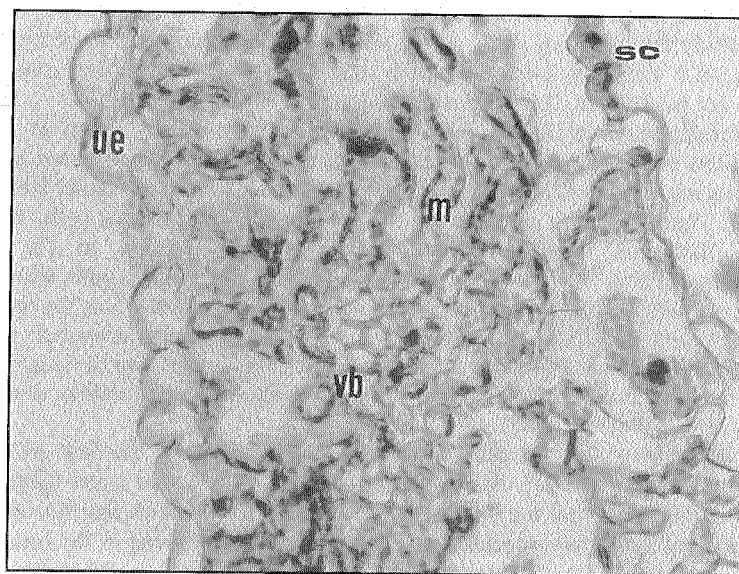
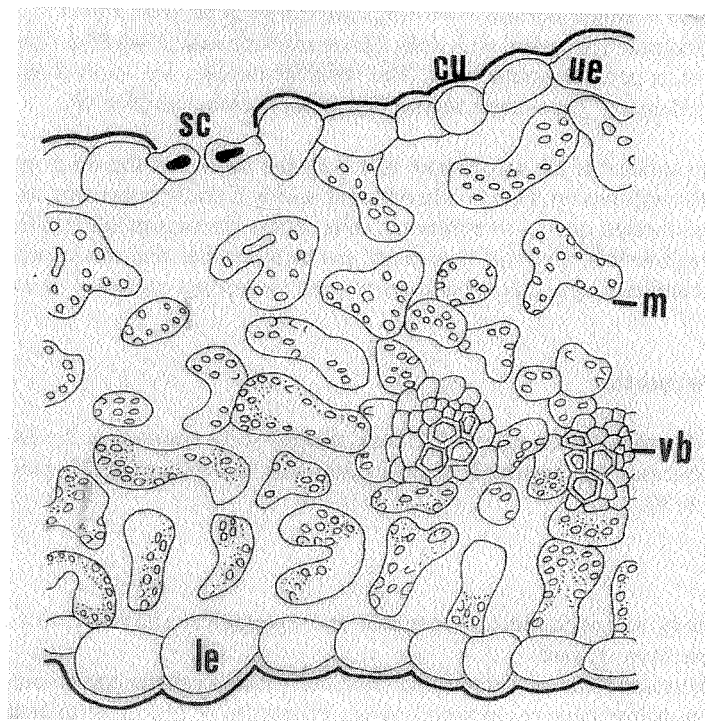


Fig. 4. Cross-section of leaf of *Lilium ciliatum* (Özdemir 037)
 Cu- cuticle; sc- stoma cell; ue- upper epidermis; m- mesophyll;
 le- lower epidermis; vb- vascular bundle.

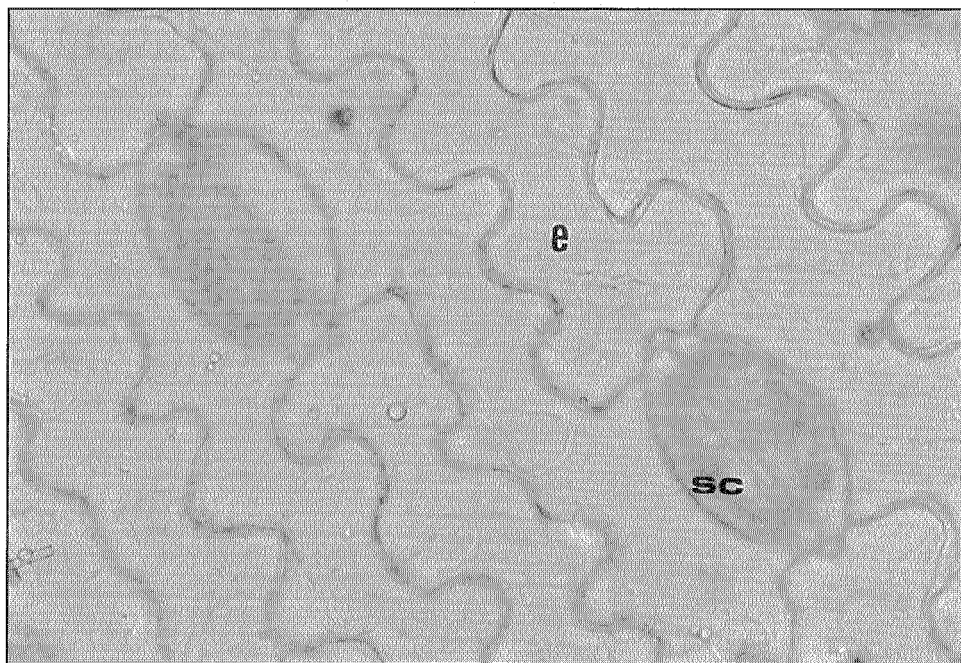
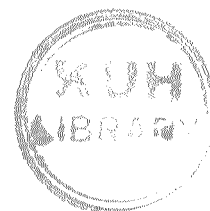
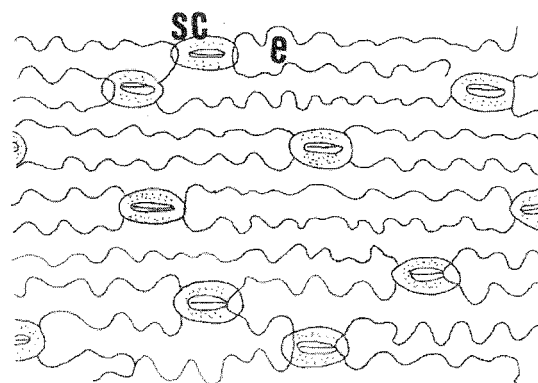


Fig. 5. Surface-section of leaf of *Lilium ciliatum* (Özdemir 037)
e- epidermis; sc- stoma cell.

A few studies have been carried out on the chromosomes of the species *Lilium*. Song *et al.*, (1996) observed the somatic chromosome number of *Lilium formosanum* as $2n=24$ (15), Noda *et al.*, (1993) observed the somatic chromosome number of *Lilium bulbiferum* as $2n=36$ (16.) and Yamaguchi *et al.*, found chromosome number of *Lilium nepelense* as $2n=24$ (17). In this study, the chromosome number of *Lilium ciliatum* has been determined as $2n= 24$.

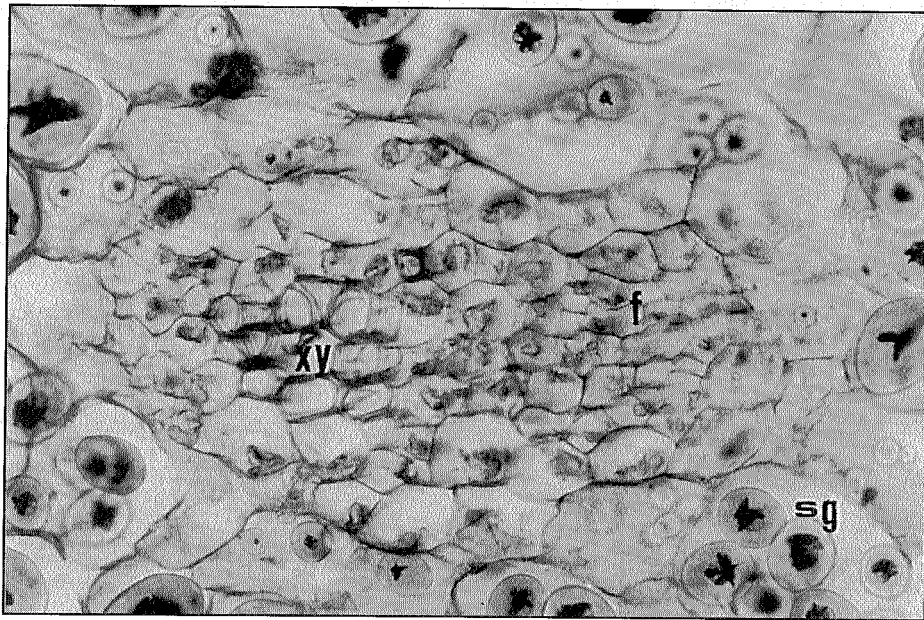
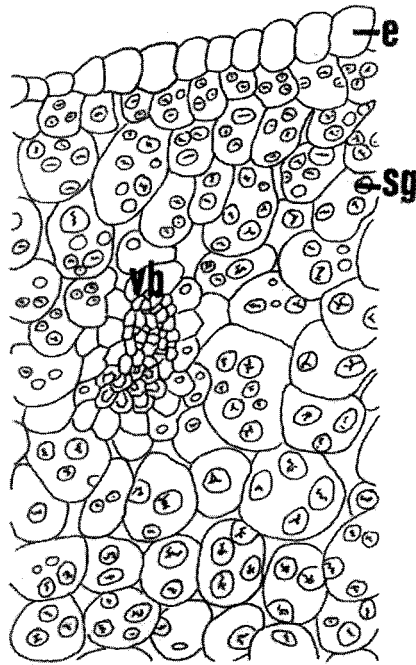


Fig. 6. Cross-section of bulb of *Lilium ciliatum* (Özdemir 037)
e- upper epidermis; sg- starch grain; vb- vascular bundle.

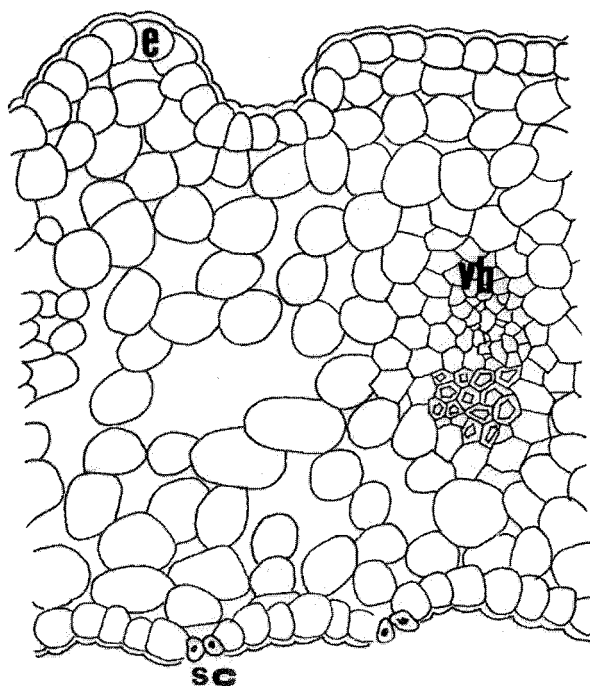


Fig. 7. Cross-section of flower of *Lilium ciliatum* (Özdemir 037)
e- epidermis; sc- stoma; vb- vascular bundle.



Fig. 8. Mitotic metaphase chromosomes at the root tips
(The microphotographs) 10x40.

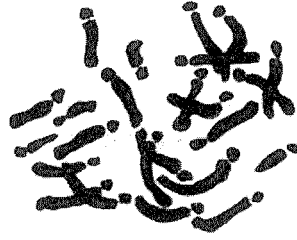


Fig. 9. Mitotic metaphase chromosomes at the root tips.

There is need to carry out research studies in the morphological, anatomical and cytological characteristic of other species of *Lilium* which have economical value.

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(Received for publication 15 June 2001)