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Objektyp: **Article**

Zeitschrift: **Candollea : journal international de botanique systématique = international journal of systematic botany**

Band (Jahr): **43 (1988)**

Heft 1

PDF erstellt am: **18.07.2024**

Persistenter Link: <https://doi.org/10.5169/seals-879728>

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Micromorphological and anatomical structure of the seed-testa of some *Colchicum* (Liliaceae) species

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RÉSUMÉ

KÜÇÜKER, O. & T. ÇELEBIOĞLU (1988). Structure micromorphologique et anatomique de la testa de la graine de quelques espèces de *Colchicum* (Liliaceae). *Candollea* 43: 129-138. En anglais, résumés français et anglais.

Les graines des trois espèces (*Colchicum chalcedonicum* Azn., *C. lingulatum* Boiss. & Spruner et *C. turcicum* Janka) qui posent des problèmes taxonomiques ont été examinées aux points de vue morphologique et anatomique. D'après les observations au MEB, la surface des graines présente un caractère ridé. Ce relief est identifié comme suit: chez *C. chalcedonicum*, il est "irregularis sinuosus rugosus", chez *C. lingulatum* "cavitatis rugosus" et chez *C. turcicum* "plicatus rugosus". Pour les études anatomiques, les auteurs ont utilisé des coupes transversales de graines et les vues de surface des tissus de la testa, isolés par dissection sous la loupe binoculaire. Se basant sur certaines différences importantes, observées dans ce travail, les auteurs préconisent le maintien des *C. chalcedonicum*, *C. lingulatum* et *C. turcicum* comme trois espèces différentes.

ABSTRACT

KÜÇÜKER, O. & T. ÇELEBIOĞLU (1988). Micromorphological and anatomical structure of the seed-testa of some *Colchicum* (Liliaceae) species. *Candollea* 43: 129-138. In English, French and English abstracts.

The seeds of three species of *Colchicum* which offer taxonomical problems: *C. chalcedonicum* Azn., *C. lingulatum* Boiss. & Spruner, and *C. turcicum* Janka have been investigated morphologically and anatomically. According to SEM, the micromorphological features of the seed surfaces have been determined as a wrinkled appearance. This relief has been identified in the following manner: "irregularis sinuosus rugosus" in *C. chalcedonicum*, "cavitatis rugosus" in *C. lingulatum* and "plicatus rugosus" in *C. turcicum*. For anatomical purposes, the cross-sections of the seeds and the preparations obtained by dissecting the tissues of the testa under the stereo-microscope have been used (surface views). In the conclusion based on notable differences, it has been suggested that *Colchicum chalcedonicum*, *C. lingulatum* and *C. turcicum* deserve the taxonomic status of three different species.

Introduction

In the flora of Turkey, the genus *Colchicum* gains an importance on account of the large number of its species and the wide fields it covers.

Relatively few studies have been devoted to turkish *Colchicum* species. Partial works were published on the morphology and anatomy of organs of some species (KASAPLIGIL, 1961; ÖZYURT, 1978). One of the first detailed investigation is the study of KÜÇÜKER (1985), the results of which have induced similar works about other species of the genus *Colchicum* (KÜÇÜKER, 1986, in press).

The examined *Colchicum* species, namely *C. chalcedonicum* Azn., *C. lingulatum* Boiss. & Spruner and *C. turcicum* Janka raise taxonomical problems (cf. BRICKELL, 1980 and 1984).

C. chalcedonicum which is one of the endemics of the Asiatic side of the Bosphorus and has been described as a species for the first time by AZNAVOUR (1897), was reduced to the level of a variety of *C. turcicum* by STEFANOFF (1926). Later on, the same species has been indicated as a synonym of *C. turcicum* in the "Flora Europaea" by BRICKELL (1980) and as a synonym of *C. lingulatum* in the "Flora of Turkey" (BRICKELL, 1984). Another *Colchicum* species of the *C. lingulatum* group which has been found in Turkey by BAYTOP & LEEP (1977) was given as a synonym, this time, of *C. chalcedonicum* by BRICKELL (1984).

On account of the various treatments by different authors of the above mentioned species, our studies were started primarily with these species. In order to solve this taxonomical problem, we have investigated also the features of the structure of the seed coat.

Material and methods

The species investigated *C. chalcedonicum* Azn. (83-3/2 and 83-13/3) was obtained from Yakacik-Aydos Mount, Istanbul. *C. lingulatum* Boiss. & Spruner (85-3/1 and 85-10/1) was collected from Marmaris-Datça, Mugla and *C. turcicum* Janka (82-8/1 and 82-18/2) was collected from Durusu (= Terkos) Town, Istanbul. All the living plants were cultivated in the Botanical Garden.

For the morphological examinations we used stereo(dissection)-microscope and SEM. The seeds chosen under the stereo-microscope were prepared for examination according to ÇELEBIOĞLU & al. (1983) and were observed with Philips PSEM-500 under $\times 80$, 320 and 1250 magnifications.

The description of macro-morphological characteristics of the seeds and of the testa relief were made according to LINDLEY (1964), STEARN (1973), ROBERT (1982) and MIÈGE & WÜEST (1984).

The seeds were soaked in 5% KOH at 25°C for 48 hours to separate the layers of tissues forming the testa. The softened seeds were dissected under the stereo-microscope and the separate tissue-pieces were taken into 1-2 drops of Sartur solution (ÇELEBIOĞLU, 1949) for their temporary preparations.

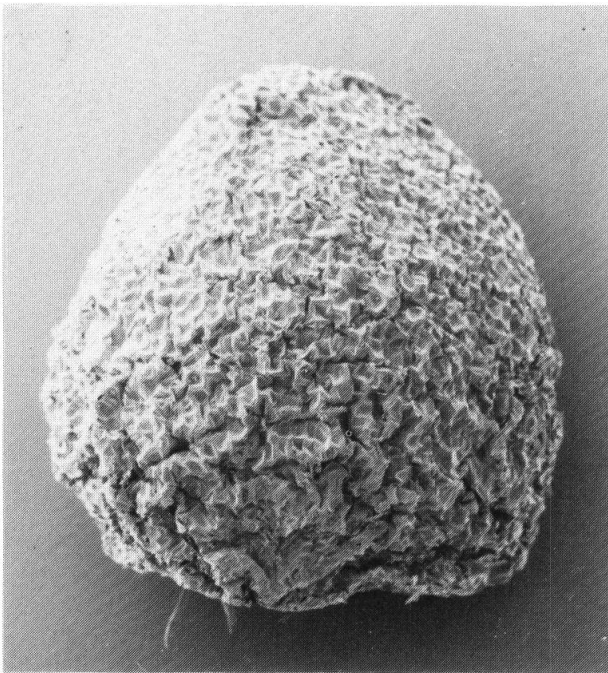
Morphological observations

The seeds of the examined species are spherical in shape (Fig. 1-3) and have wrinkled surfaces with various shades of brown. However these features show some differences between the species. The macro-morphological characteristics observed under the stereo-microscope were summarized in Table 1. When the seeds were observed under SEM ($\times 80$) the wrinkles on the seed-coat surfaces were seen as foldings (Fig. 1-3). Under higher magnifications ($\times 320$ and $\times 1250$), these foldings show, from one species to the others, some differences which, after BARTHLOTT (1984), have taxonomic importance (Figs. 4-7). During the examination of the seed surface by different magnifications without any pretreatment, one could not observe the traces of epidermal cells which can be seen from the surface.

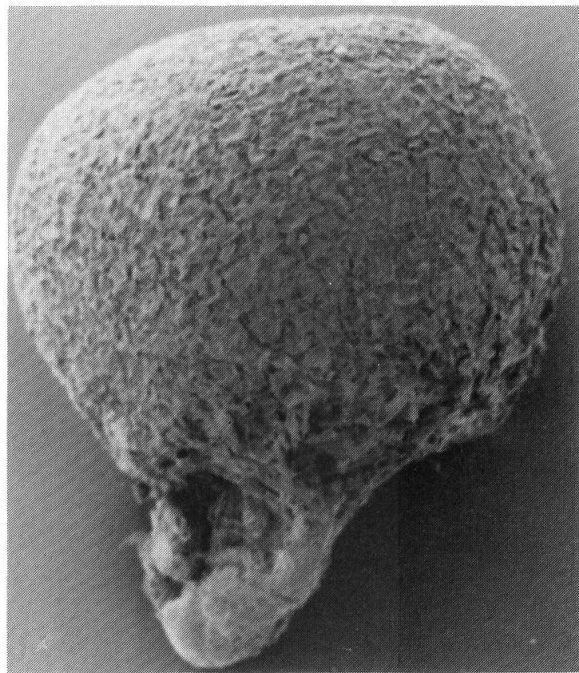
The appearances of the testa surfaces of the different species are as follows: *C. chalcedonicum* has wrinkles and irregular foldings. This surface appearance may be determined as "irregularis sinuosus rugosus" (Fig. 5). *C. lingulatum* shows wrinkles and foldings like *C. chalcedonicum*. However these wrinkles and foldings consist of cavities and may be described as "cavitatis rugosus" (Fig. 6). The wrinkles on the testa surface of *C. turcicum* are different from those of the other species, for they consist of big and small repeating plications. This appearance of surface (Fig. 7) may be named as "plicatus rugosus".

Anatomical observations

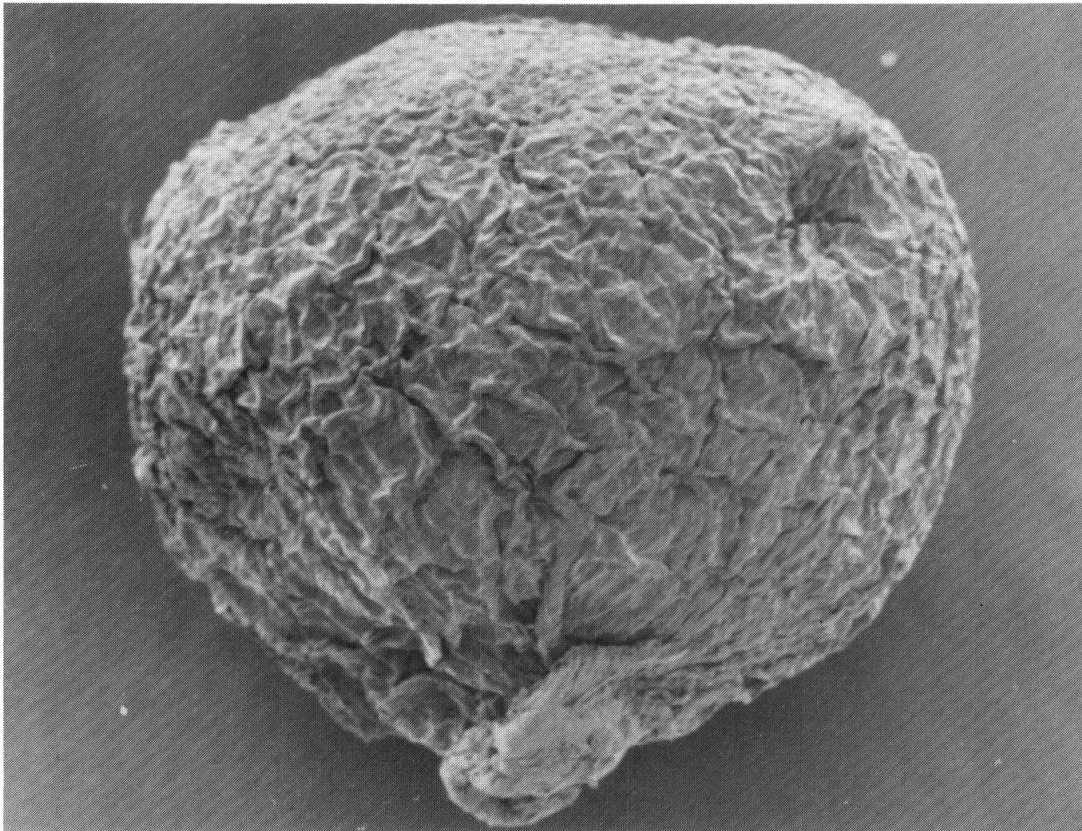
The testa of the *Colchicum* seeds consists of epidermis, parenchyma and pigment layer cells (NETOLITZKY, 1926; ÇELEBIOĞLU, 1949; EL-HAMIDI & FAHMY, 1961; BAYTOP, 1966).



1



2



3

Fig. 1-3. — The seeds of *Colchicum* (SEM, $\times 40$).
1, *C. chalconicum*; 2, *C. turcicum*; 3, *C. lingulatum*.

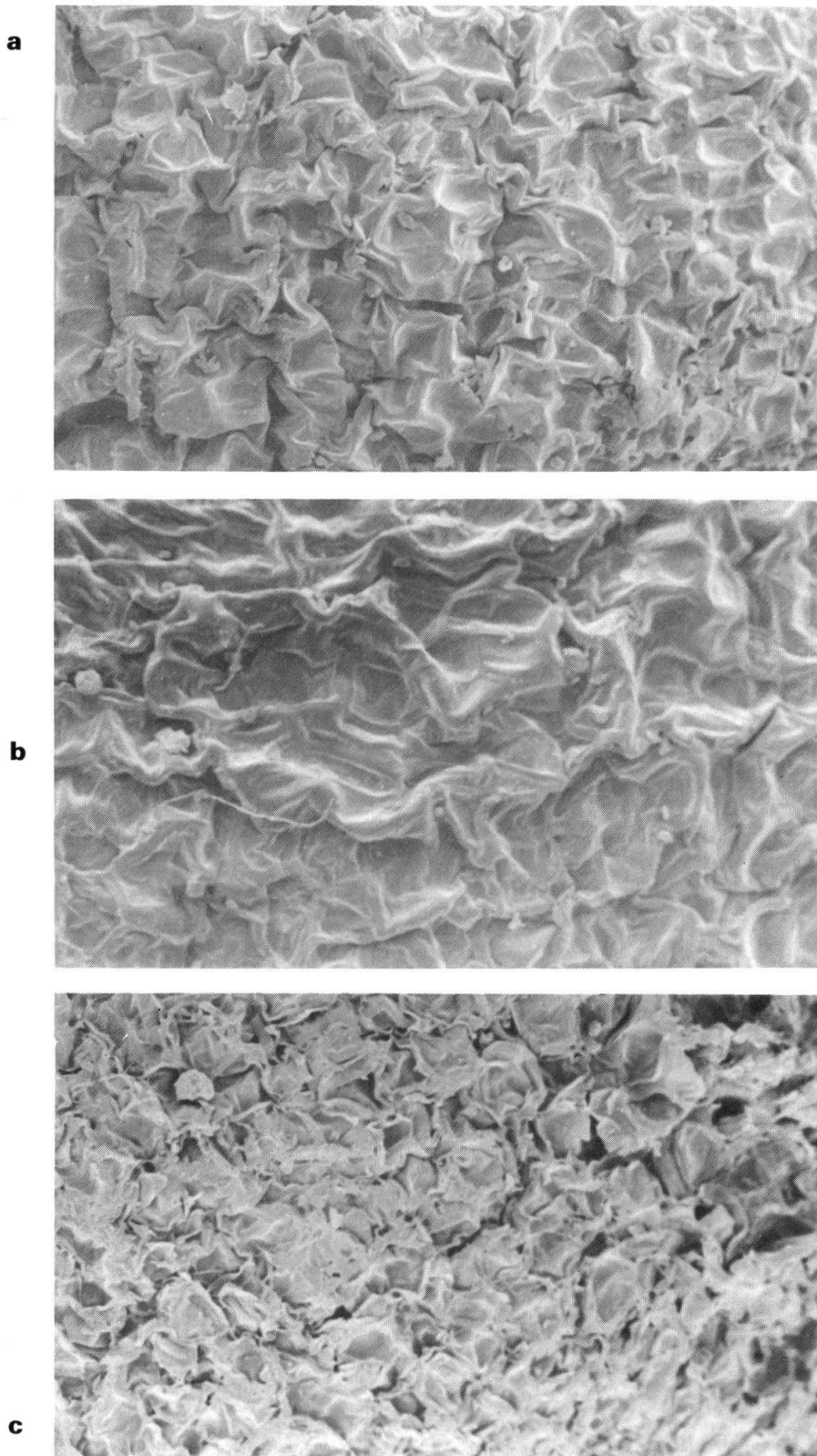
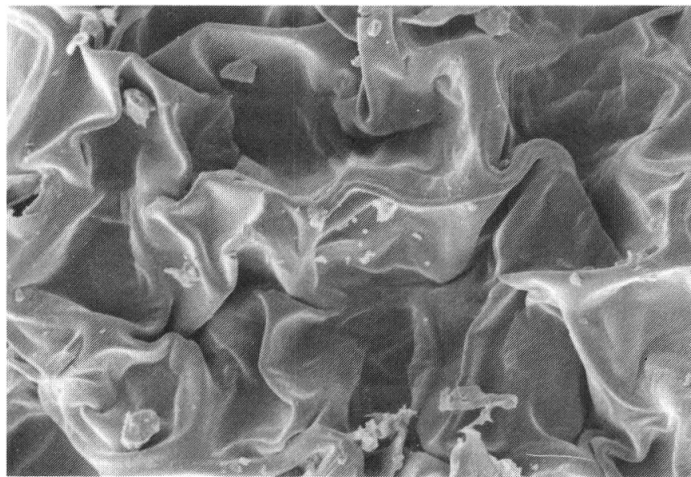
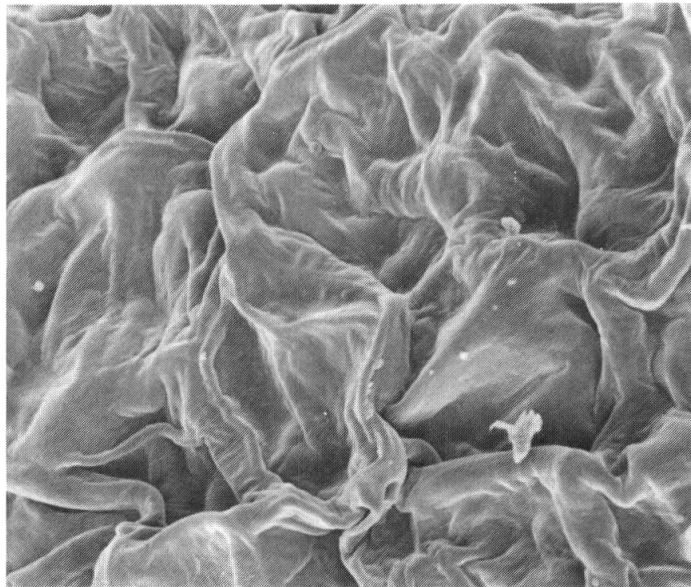


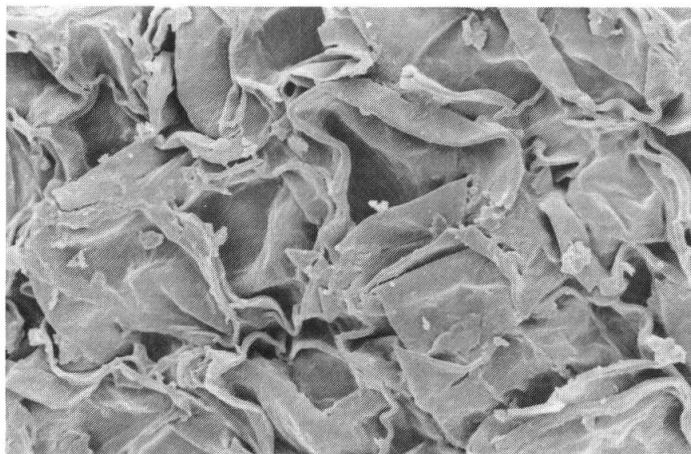
Fig. 4. — The testa relief of *Colchicum* seeds (SEM, $\times 100$).
a, *C. chalcedonicum*; b, *C. linguatum*; c, *C. turcicum*.



5



6



7

Fig. 5-7. — The testa relief of *Colchicum* seeds (SEM, $\times 400$).
5, *C. chalcedonicum*; 6, *C. lingulatum*; 7, *C. turcicum*.

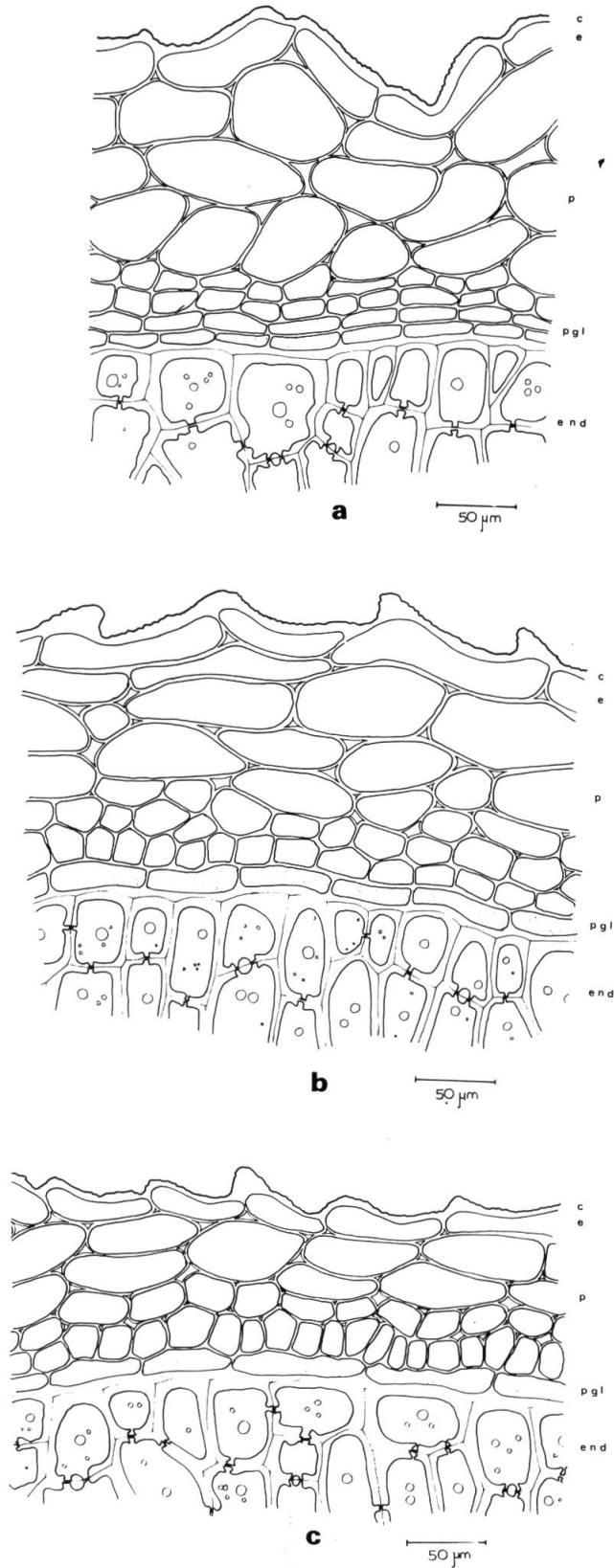


Fig. 8. — The transverse sections of the testa of the species. **a**, *Colchicum chalconicum*; **b**, *C. lingulatum*; **c**, *C. turcicum*. c = cuticle; e = epidermis; p = parenchyma; pgl = pigment layer cells; end = endosperm.

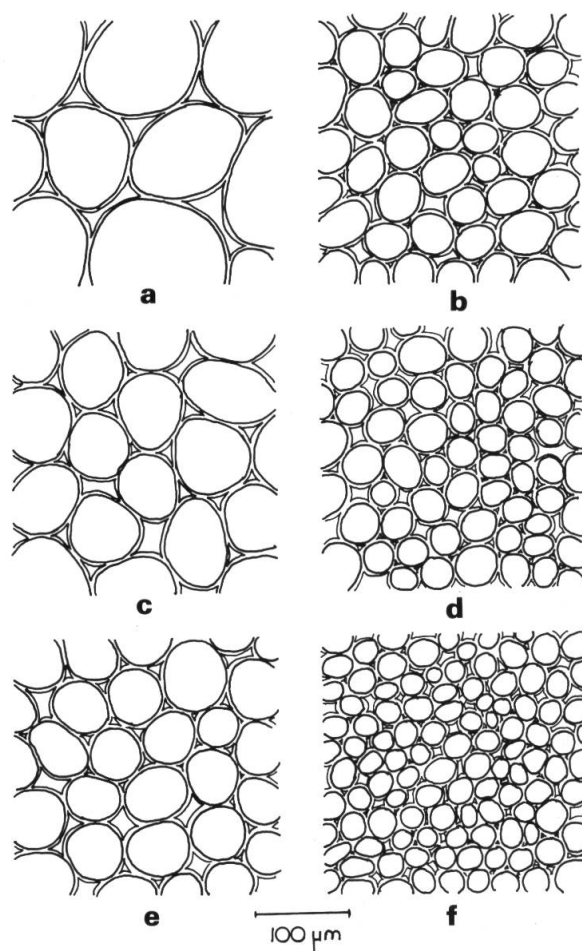


Fig. 9. — The surface views of the parenchyma cells of the testa.
a-b, *Colchicum lingulatum*; c-d, *C. chalcedonicum*; e-f, *C. turcicum*.

There are some differences and similarities between the testa structures of the three investigated species, which can be seen during the examination of the transversal sections and the surface views of the testa (Figs. 8-9).

The epidermis

In transversal sections the epidermis consists of irregular long and flattened cells (Fig. 8). By *C. lingulatum*, the epidermis cells are longer than those of the other species (Fig. 8b). The outermost walls of the epidermis cells show conspicuous protrusions and they are generally undulate. The cuticle layer is rather thick in all the three species and there are thick places which are different from species to species. The wall undulations and cavities which were seen in transversal sections have been determined in surface views of the epidermis.

The parenchyma

The parenchyma layer in *C. lingulatum* and *C. chalcedonicum* has five rows whereas in *C. turcicum* it consists of about four rows (Fig. 8c). In *C. lingulatum*, there is an uncontinuous flattened parenchyma cell row under the epidermis. The parenchyma rows which are near the epidermal cells consist of big cells; those situated near the pigment layer consist of small cells, more or less equal in shape (Fig. 8). The biggest parenchyma cells have been found in *C. lingulatum* (Fig. 8b) and the smallest cells in *C. turcicum* (Fig. 8c).

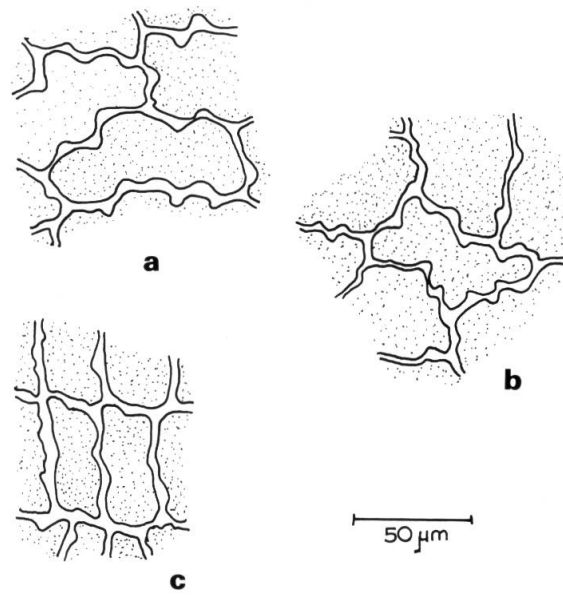


Fig. 10. — The surface views of the pigment layer cells of the testa.
a, *Colchicum turcicum*; **b**, *C. lingulatum*; **c**, *C. chalconicum*.

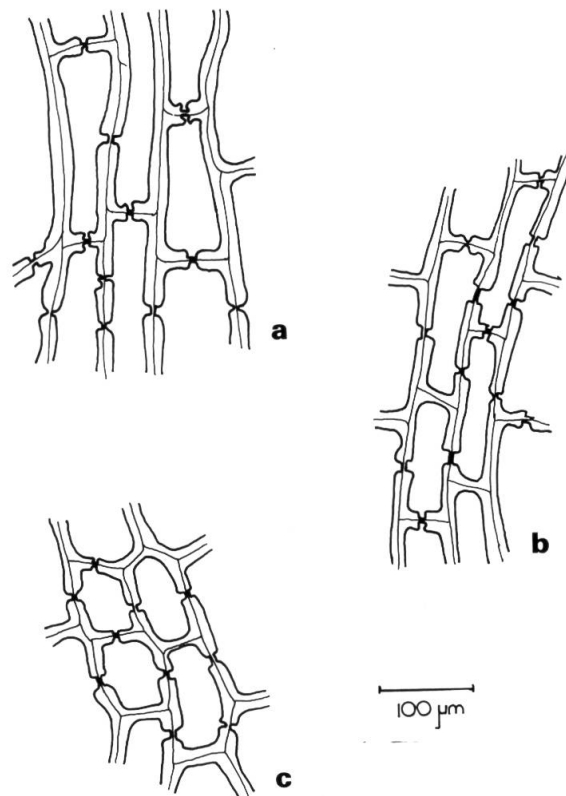


Fig. 11. — The transverse sections of the endosperm cells.
a, *Colchicum lingulatum*; **b**, *C. chalconicum*; **c**, *C. turcicum*.

In the surface views, it has been established that the cells forming the parenchyma tissue are different in size in the three examined species (Fig. 9).

The pigment layer cells

In *C. chalcedonicum* this layer consists of two rows of flattened cells (Fig. 8a) whereas in the other species it consists of only one row (Fig. 8b, c). In *C. turcicum*, the pigment layer cells are seen to be more elongated (Fig. 8c). In the surface views there are some thickenings enlarging the surface of the cell wall and the cells are different in shape according to their species (Fig. 10).

The endosperm

The endosperm of all the investigated species consists of wide and long parenchyma cells which have thick cell walls and numerous simple pits (Fig. 11). These cells contain numerous aleuron grains and lipid drops. The row of endosperm cells which is near the layer of pigment cells consists of smaller cells. The endosperm cells like those of the epidermis and parenchyma are different in size from species to species. The biggest endosperm cells have been observed in *C. lingulatum* whereas the smallest cells have been found in *C. turcicum* (Fig. 11b, c).

Discussion

The results obtained from this survey show that there are some similarities besides many differences between the seed testas. There are also conspicuous differences between the diameters of seeds of the species. According to macro-morphological findings, *C. lingulatum* has the biggest seeds which are 2.9-3.5 mm in diameter (Table 1).

	<i>C. chalcedonicum</i>	<i>C. lingulatum</i>	<i>C. turcicum</i>
Shape	± spherical (± conical-globose)	± compressed-spherical (± napiform-globose)	compressed-spherical (napiform-globose)
Diameter (mm)	1.7-2.5	2.9-3.5	1.8-2.0
Colour	light-brown (<i>ferrugineus</i>)	brownish-yellow (<i>testaceus</i>)	reddish-brown (<i>porphyreus</i>)
Caruncle.....	long and narrow	wide	fairly wide
Surface	wrinkled (<i>rugosus</i>)	wrinkled (<i>rugosus</i>)	wrinkled (<i>rugosus</i>)

Table 1. — The macromorphological features of the seeds of the examined *Colchicum* species.

The ornamentation features of the seed surface and its relief are different from one species to another, even by high magnifications ($\times 1250$). This fact has been noted as an important taxonomical criterion.

The anatomical findings show that there are some specific distinctive features in the cell sizes and in the distribution of the cells. The differences in shape and wall structure of the pigment cells are especially important.

According to BRICKELL (1980, 1984), the taxonomical status of the *Colchicum* species that we have examined is controversial. Therefore, the investigation of anatomical, macro- and micromorphological features of the seed-coat should be regarded as helpful to solve this important problem.

As it was already suggested by KÜÇÜKER (1985) on the basis of the results of such investigations, the taxonomical status of *C. turcicum* and *C. lingulatum* must be preserved as the one of two different species. This conclusion correlates with the results of KÜÇÜKER (1986, in press).

According to the results of the present study, *C. chalcedonicum* can neither be accepted as a synonym of *C. turcicum* nor of *C. lingulatum* as BRICKELL (1980, 1984) has stated, but preserved as a different species.

ACKNOWLEDGEMENTS

We should like to express special thanks to Professor Claude Favarger (Department of Botany, University of Neuchâtel, Switzerland) for his constant advice and scientific support.

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