FRITILLARIA ATROLINEATA (LILIACEAE), A NEW SPECIES FROM IRAN

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A new *Fritillaria* species, *F. atrolineata*, is described from Iran. The new species, an endemic to Western Azarbaijan, belongs to the *F. caucasica* group, sect. *Olostyleae*, subgenus *Fritillaria*. SEM studies of nectaries, stamen, pollen and styles are presented. Differences from other Iranian species in the *Caucasica* group are discussed. The chromosome number is $2n = 24$.

Keywords. *Fritillaria*, Iran, karyology, new species, SEM studies.

Fritillaria atrolineata Bakhshi Khaniki, **sp. nov. Figs 1, 2.**
Habitu et perianthii colore *F. chloranthae*, ab ea differt statura majore, foliis glaucis suboppositis vel subternatis, perianthio anguste campanulato, sed praesertim nectariis longis linearibus nigris.
Typus: Iran, Western Azarbaijan, Urmiah, Shohada (Ghasemlu) valley, 1500–1800m, rock crevices in moist sand below cliffs, 8 v 1994, *G. Bakhshi Khaniki* 63 (holo. GB).

Bulb globose–subglobose, 7–11 × 7–10mm; without bulbils or stolons. *Stem* 20–25cm above the bulb, longer in fruit, smooth. *Leaves* 4–5, glaucous, the lowest 2–3 usually in a subternate (subverticillate) or subopposite position, the rest alternate, the lowest 9 × 1–1.5cm, usually 8–9 times as long as wide, oblanceolate, the uppermost (bract leaf) 8.5 × 0.3cm, linear to narrowly oblanceolate, acute. *Flower* 1 (2), narrowly campanulate, perianth segments usually yellowish-green to green, outside more yellowish towards margins, sometimes sparsely brown-dotted, inside tinged or sparsely dotted, pale reddish-brown towards margins, outer segments 20 × 6mm, oblanceolate, obtuse, inner ones 8mm wide, oblanceolate, obtuse, fascia obscure. *Nectaries* linear, 4–6 × 0.5–1mm, placed 0.5–1mm above base of tepals, black. *Filaments* 7mm, yellow, densely papillose in upper part. *Anthers* 6–7mm long before dehiscence, ellipsoid, yellow, basifixed. *Style* 5–7mm, stout, greenish-yellow, densely papillose, entire or very slightly 3-lobed, apex of stigma lobes papillose and with a central hole. *Ovary* 3-locular, 6–8mm, stout, green. *Capsule* 2.5–3 × 1.5cm, obovoid, tapering towards the base, obtuse, not winged. *Seeds* flat, ovate in outline, 4–5mm long. Flowers April.

Fritillaria atrolineata can be classified in subgenus *Fritillaria*, sect. *Olostyleae* (Boiss). Rix in ed. and more specifically in the *F. caucasica* group, not only because of its narrowly campanulate flowers but above all on the basis of its comparatively small overall size, and shape, position and colour of the nectaries.

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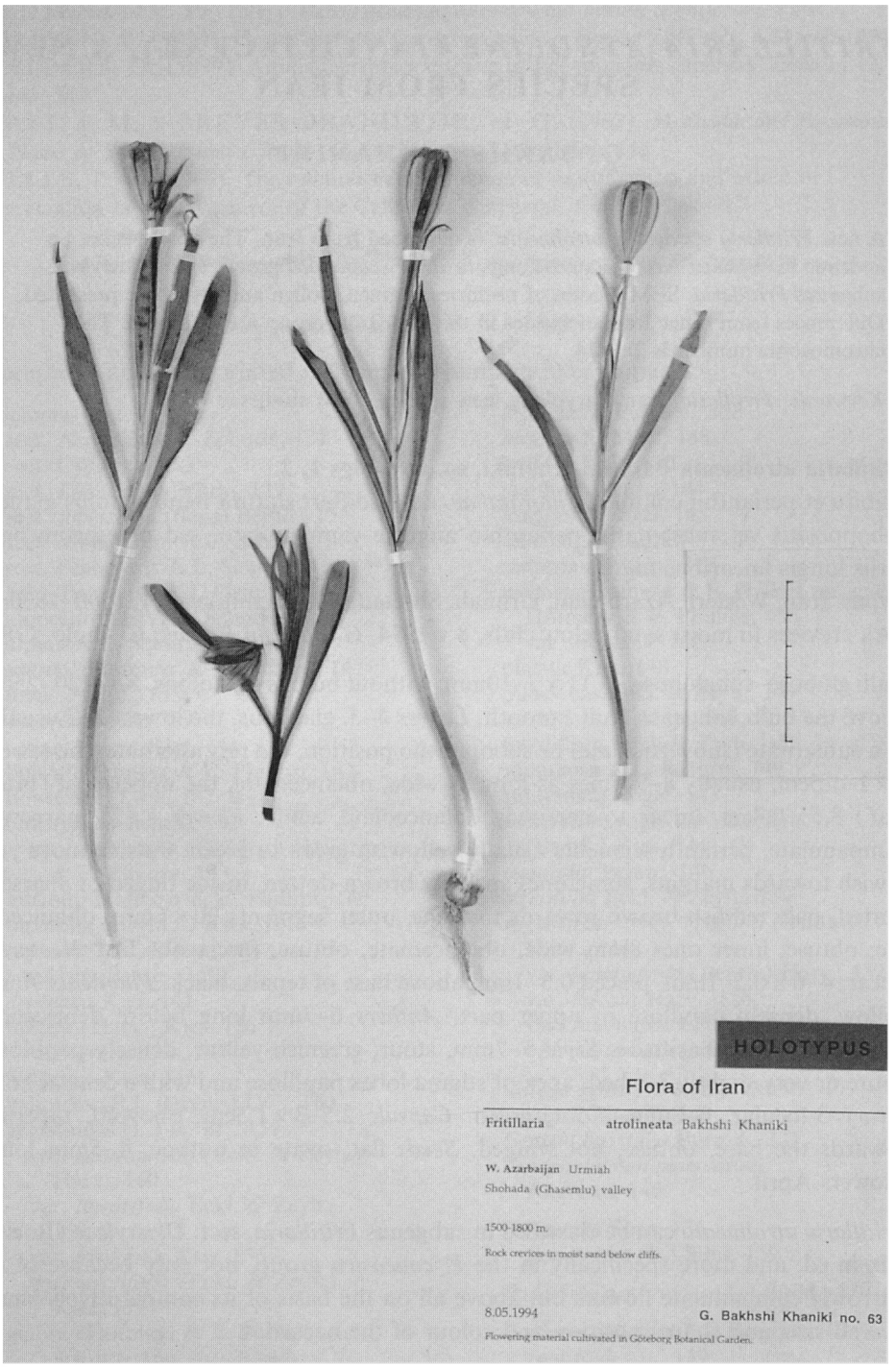

FIG. 1. *F. atrolineata.* Holotype (in fruit), with flowering specimens from cultivation.

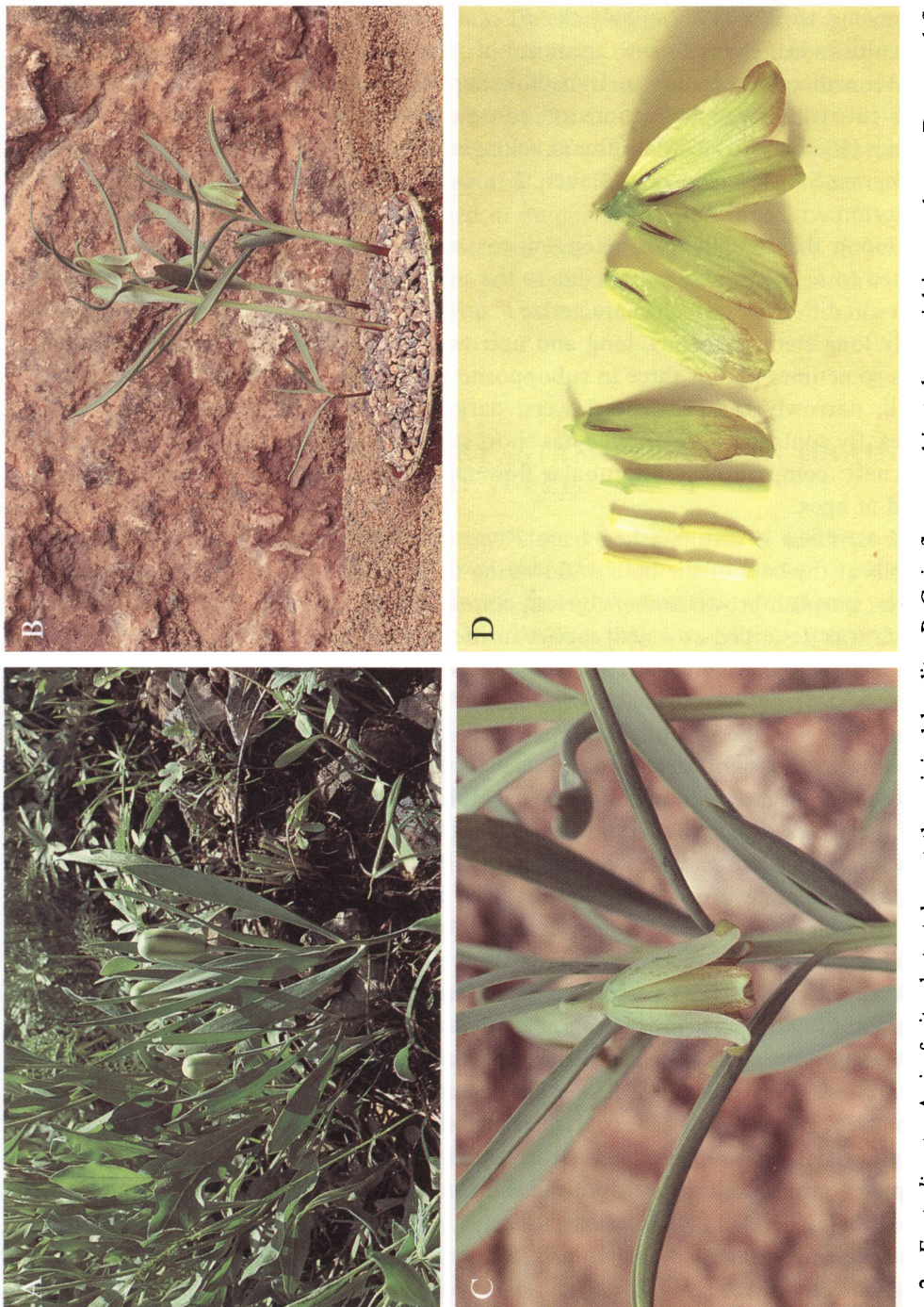

FIG. 2. *F. atrolineata*. A, in fruit, photo taken at the original locality; B–C, in flower, cultivated material in greenhouse; D, opened flower showing nectary colour and position on tepal, stamens and style.

Fritillaria in Iran is relatively poor in species (c.15) compared with Turkey (c.30). According to Rix (1977, 1984) the *F. caucasica* group presents many taxonomic difficulties in Turkey, on account of frequent hybridization, resulting in ±intermediate specimens. In Iran, however, differences between species are more clear-cut, with fewer indications of introgression. Here, five previously described species (Rechinger, 1990) are found belonging to this complex: *F. caucasica* Adams, *F. zagrica* Stapf, *F. assyriaca* Baker, *F. uva-vulpis* Rix and *F. chlorantha* Hausskn. & Bornm.

Among the Iranian taxa belonging to the complex, *F. atrolineata* seems to be related to *F. chlorantha,* mainly due to the colour of its flowers. There are, however, clear-cut differences which characterize *F. atrolineata* as a distinct species: a comparatively long stem; glaucous, long and narrowly oblanceolate leaves with the lowest ones sometimes two or three in subopposite or subverticillate (subternate) position; small, narrowly campanulate flowers; dark, elongate linear nectaries, and entire styles. By contrast, *F. chlorantha* has short stems; short, wide, shiny green leaves, all alternate; comparatively big tubular flowers; green, lanceolate nectaries, and styles trifid at apex.

F. assyriaca is distinguished from *F. atrolineata* by the presence of 3–12 small bulbils at the base of the bulb at flowering time; papillose stem; linear, canaliculate leaves; purplish-brown anthers; green, elliptic-oblong nectaries. As for *F. uva-vulpis* which was described as a new species in the *F. caucasica* group by Rix (1974), the presence of four widely spaced, green, lanceolate leaves; rounded flowers and wide, ovate nectaries separates that species from *F. atrolineata.*

In *F. zagrica*, the stems are comparatively short, and the tepals are dark purplish-brown with a bright yellow apex, whereas in *F. atrolineata*, stems are taller and flowers are bright green without any dark bloom.

F. caucasica, finally, differs in phyllotaxy (leaves are all alternate), flower colour, which is purplish in *F. caucasica* but green in *F. atrolineata*, nectary colour and shape (green, lanceolate versus black, linear), and vestiture of filaments and styles. These are smooth or only sparsely papillose in *F. caucasica* in contrast to the densely papillose clothing in *F. atrolineata.*

A key to the Iranian species of the *F. caucasica* group is included in Bakhshi Khaniki (1997).

Among non-Iranian species, some forms of *F. pinardii* are superficially similar to *F. atrolineata* on account of flower shape but differ in stem pubescence (sometimes papillose), phyllotaxy (leaves all alternate, shorter and wider), nectary colour and shape (green versus black, linear-lanceolate versus long-linear), general appearance of pollen grain and exine sculpturing.

KARYOLOGY

The chromosome number of *F. atrolineata* is $2n = 24$ (Fig. 6A), similar to the majority of the species of the genus *Fritillaria* (see Fedorov, 1969, and more specifically:

Darlington, 1930; La Cour, 1978; Koul & Wafai, 1980; Moore, 1982; Kamari, 1984, 1991, 1993; Zaharof, 1989; Basak, 1991). The karyotype of the genus is bimodal, always consisting of two large symmetric (metacentric and submetacentric, nos. 1 and 2 in Fig. 6B) chromosome pairs, the remaining chromosomes being ±asymmetric (subtelocentric and telocentric) (La Cour, 1978; Kamari, 1991). In *F. atrolineata*, the karyotype formula is $2n=2x=24=4m+16t+4st$ (nomenclature for centromeric position according to Levan et al., 1965). Secondary constrictions were also visible in different plates but varied in number and appearance, two of which (pairs nos. 2 and 8 in Fig. 6B) are presented here (arrows in Fig. 6A). A haploid idiogram based on the measurements of eight metaphase plates is shown in Fig. 6B.

SEM STUDIES OF NECTARY, STAMEN, POLLEN GRAIN AND STYLE

As mentioned earlier, the elongate linear nectary of a black colour against a green background is one of the most important characters in *F. atrolineata*. A scanning electron microscopy (SEM) study shows that the nectaries are placed at the base of the perianth segments (Fig. 3A, B) and that the cells of the nectaries are smaller and narrower, and more rectangular, than those of the nectary borders and tepal surface (Fig. 3C, D), probably reflecting their role in nectar sugar secretion.

The attachment of anther to filament has been used for sectional characterization but further investigations on this are needed. There are generally two kinds of attachment, basifixed and dorsifixed. In *F. atrolineata* attachment is basal (Fig. 3E). Another androecial character of doubtful value, which has been used by taxonomists, is the presence or absence of papillae on the filaments. In *F. atrolineata*, filaments are densely papillose in the upper part and glabrous at the base (Fig. 3E, F). The shape and size of the anthers also have some importance but a word of warning must be given here. The anthers change very much with age and especially after dehiscence. Many published anther characters are useless or misleading because the author has not stated whether indehisced or dehisced anthers were studied. In *F. atrolineata* the indehisced anther is ellipsoid.

Pollen grains in *F. atrolineata* are monocolpate (monosulcate) (Fig. 5A). The general shape of the pollen grains in this species is ellipsoid. Exine seems to be rough (not smooth) due to very small granulae. It is foveolate with bigger and smaller luminae. The biggest holes are mainly concentrated laterally (Fig. 5B). The pollen grains are sometimes covered by pollen-kitt. The pollen shape and exine structure in *F. atrolineata* are rather close to that of *F. caucasica* but differ from other taxa in the *F. caucasica* group in general appearance, exine sculpture (presence or absence of knobs) and size of luminae.

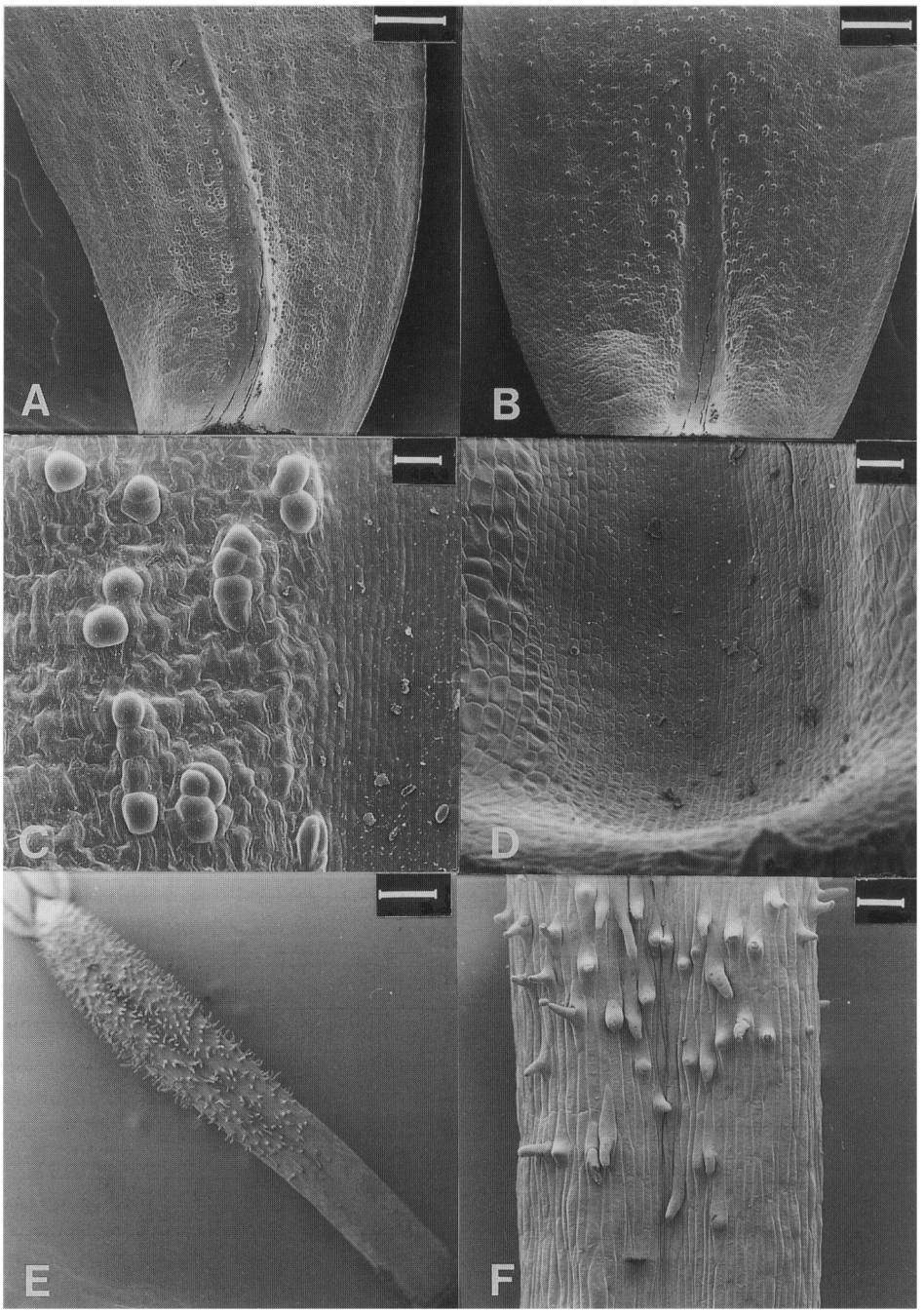

FIG. 3. *F. atrolineata*. A, nectary on inner tepal; B, nectary on outer tepal; C, cells from nectary border on inner tepal; D, nectary base (the lowest part of nectary) on outer tepal; E–F, filament. Scale bars: A, B, E = 1mm; C, D = 100μm; F = 200μm.

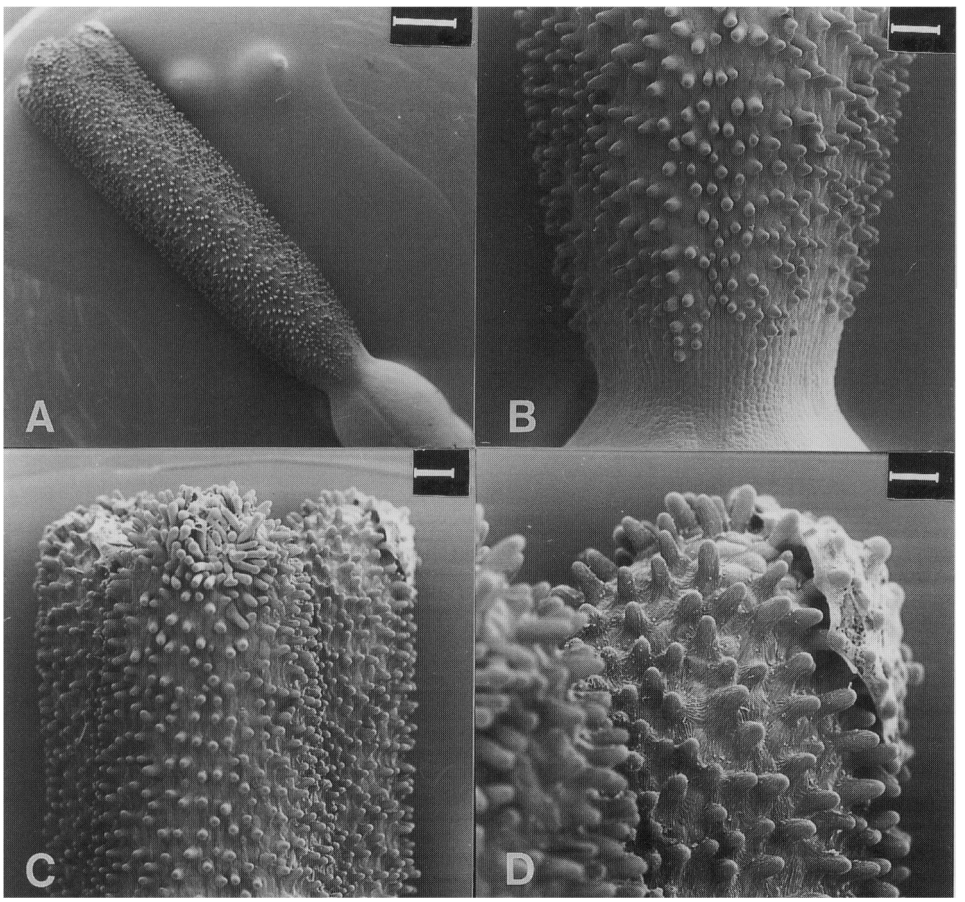

FIG. 4. *F. atrolineata*. A, style; B, style base; C–D, style apex. Scale bars: A = 1mm; B, C = 200μm; D = 100μm.

Generally, pollen is monosulcate in the genus *Fritillaria* (Radulescu, 1973), as elsewhere in the Liliaceae, but exine sculpturing is rather variable (pers. obs.).

The style is stout, and densely papillate (Fig. 4A, B). The entire or subentire style in *F. atrolineata* (Fig. 4C) separates it from some other species with trifid styles in the *F. caucasica* group (i.e. *F. chlorantha*, *F. zagrica*, *F. assyriaca*, *F. armena*, *F. minuta*, etc.). Species with the style clearly trifid form sect. *Trichostyleae*, while the others, with the style undivided or only a little trilobulate at the apex, form sect. *Olostyleae*. The distinction is generally clear enough, but sometimes there may be difficulties in deciding whether a style is shortly trifid or rather shortly lobulate. The validity of the style feature seems questionable, and according to Turrill & Sealy (1980), it would be worth considering whether there are not some species with a trifid style more closely related to species with a lobulate or undivided style than to those with which they have been associated. It seems that the end of the lobes are

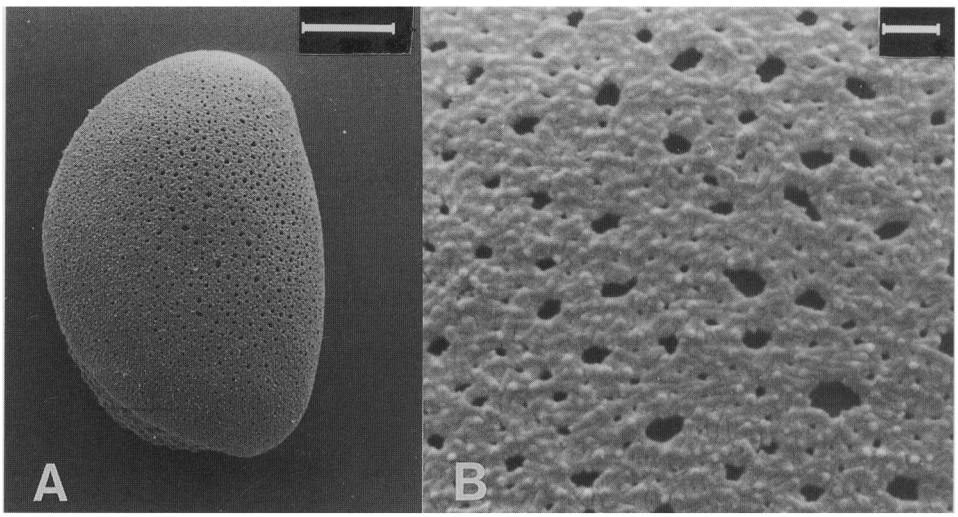

FIG. 5. *F. atrolineata*. A, pollen grain; B, exine. Scale bars: A = 10μm; B = 1μm.

more papillose (Fig. 4D, E) which is probably very important in pollen collection and germination.

PHYTOGEOGRAPHY

F. atrolineata has been collected from only one locality, Shohada (Ghasemlu) valley, in Western Azarbaijan (Fig. 7). Different parts of this province and neighbouring provinces (Eastern Azarbaijan, Kordestan, Ardabil) have been visited but the species was not observed anywhere else. It occurs in rock crevices and in moist areas below cliffs at an altitude of 1500–1800m. It is found at the base of the valley. The altitude of the mountains around the valley reaches 2500–3000m and they may serve as a barrier to dispersion. Such places are favourable for endemism and it certainly seems so far that *F. atrolineata* is an endemic species for the area in question.

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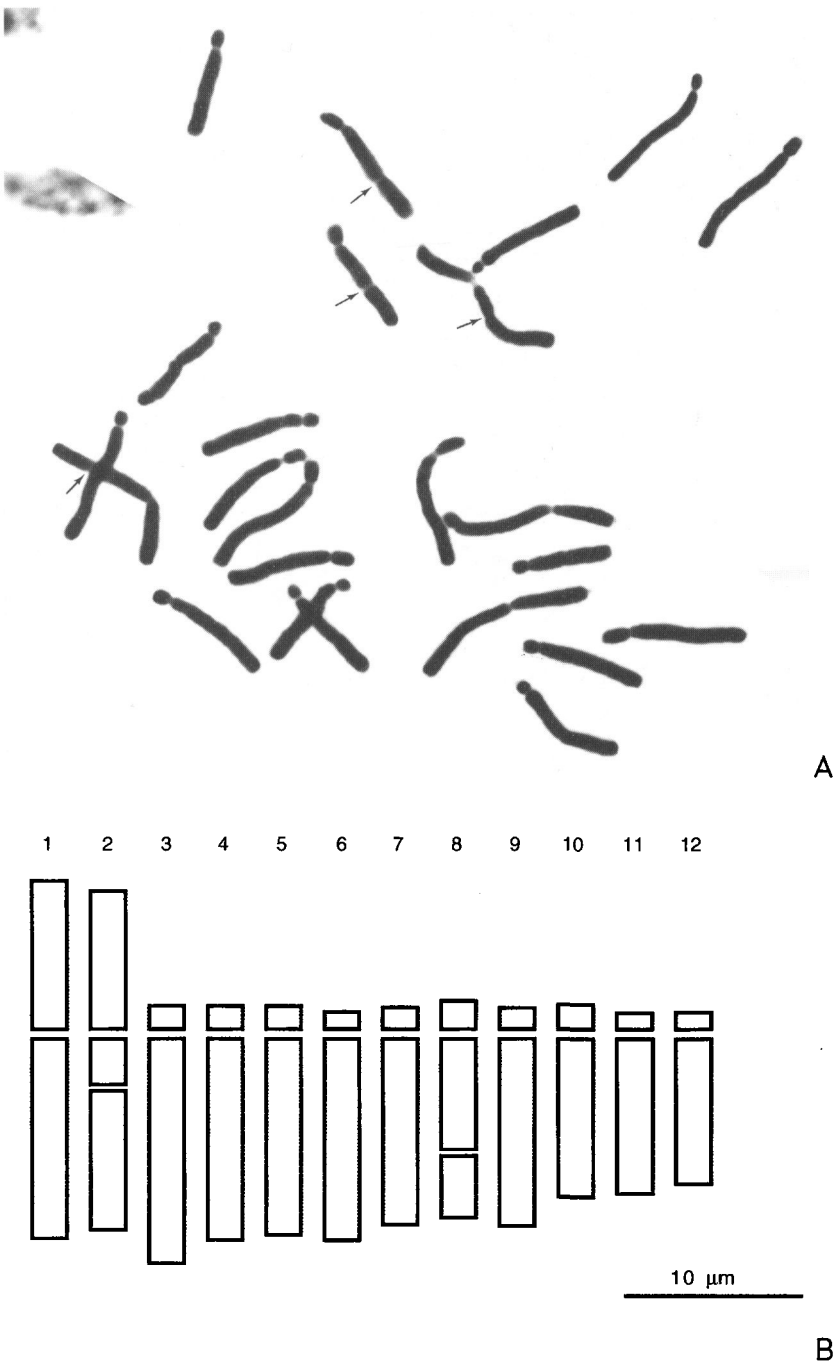

FIG. 6. *F. atrolineata.* A, mitotic metaphase (1200×, secondary constrictions are indicated by arrows); B, haploid idiogram.

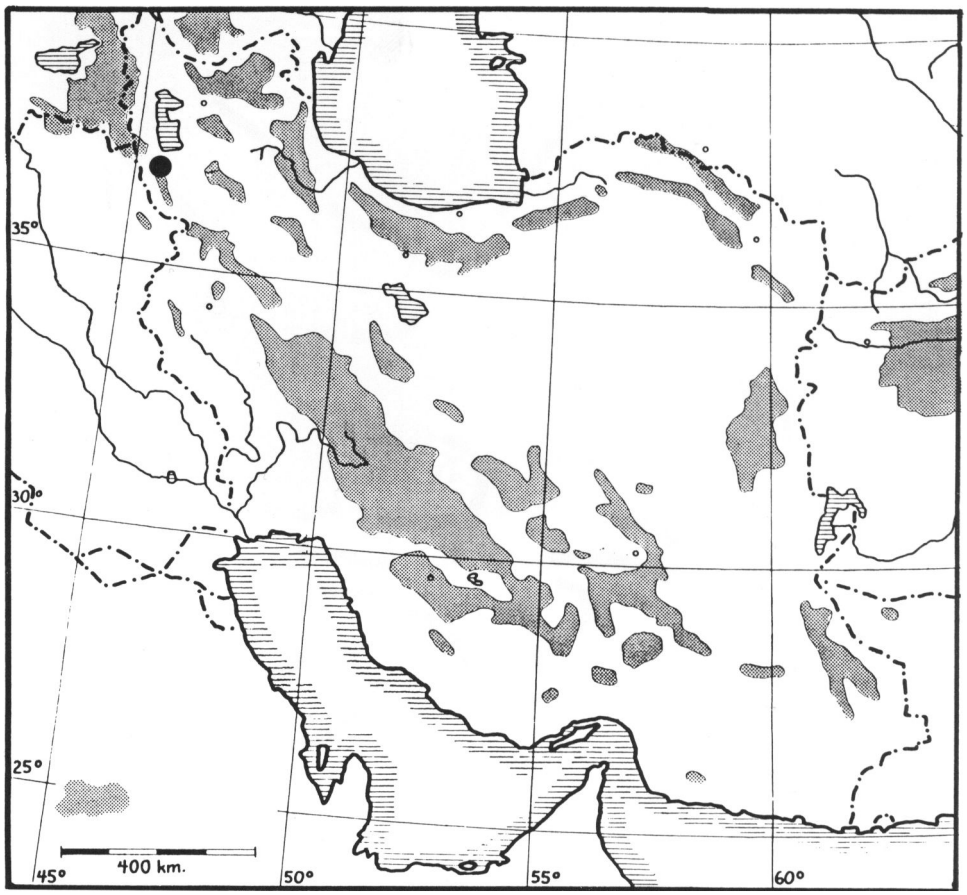

FIG. 7. *F. atrolineata*. Geographical distribution.

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