B. Petković, G. Đelić & B. Tatić

Variation in *Verbascum phoeniceum (Scrophulariaceae)* in Serbia as affected by geological substratum

Abstract

Petković, B., Đelić, G. & Tatić, B.: Variation in *Verbascum phoeniceum (Scrophulariaceae)* in Serbia as affected by geological substratum. – Bocconea 5: 647-654. 1997. – ISSN 1120-4060.

Three populations of *Verbascum phoeniceum,* growing at the same altitude and under similar climatic conditions but on different mother rock (serpentine, limestone, andesite) were compared for possible morphological and anatomical differences. Significant divergence in several features was found. The plants growing on serpentine, in particular, differ by smaller dimensions of all their parts, and in several anatomical features of their stems and leaves.

Introduction

Verbascum phoeniceum L. is a perennial growing on open, rocky ground, in dry grassland, and at the edges of sparse forests. It is known to occur on different types of mother rock. Morphological differences had been noted between specimens growing on different soils, especially on serpentine (see Pavlović 1962, Tatić & al. 1981). The influence of the substratum on the morphology and anatomy of the species was therefore investigated.

Material and methods

About 100 flowering *Verbascum phoeniceum* specimens were collected in each of three localities at about the same altitude (c. 350 m a.s.l.) and with a similar climate: Raška at the foot of Mt Kopaonik, on serpentine; Kotlenik near Kraljevo, on andesite; and Grza near Paraćin, on limestone.

The following quantitative morphological features were measured: overall height of the plant, inflorescence length, flower number per inflorescence, pedicel and petiole length, length and width of the lamina of the basal and stem leaves.

Cross-sections were made of the root (middle level), stem (first, second and uppermost internode; see Fig. 1, left), petiole and lamina (middle part) of basal leaves and first stem leaf (middle). The methods used are those described in Johansen (1940).

Table 1. Quantitative morphological features of *Verbascum phoeniceum* from different geological substrates, compared to values given in *Flora SR Srbije* and *Flora europaea.*

Character	serpentine	limestone	andesite	Nikolić (1974)	Ferguson (1972)
plant height (cm)	27-66	44-113	32.5-96	30-100	30-100
inflorescence length (cm)	6-43	17-86	6-55	–	–
number of flowers	5-44	7-110	8-74	–	–
pedicel length (cm)	0.8-2.5	1.2-2.5	1.0-2.6	1.0-3.0	1.0-2.5
basal leaves, petiole length (cm)	1.5-6.5	1.1-6.0	1.1-11.3	0.5-4.0	–
id., lamina length (cm)	3.0-7.6	5.2-13.8	3.3-14.0	4-16	4-17
id., lamina width (cm)	1.9-5.0	2.0-6.4	1.6-6.3	2-9	2.5-9

Results

A comparison between the observed morphological features and those described in *Flora SR Srbije* (Nikolić 1974: 140) and in *Flora europaea* (Ferguson 1972: 209) is made in Table 1. Some corrections to the published descriptions of *Verbascum phoeniceum* will be necessary: the overall size, said to be 30-100 cm, is in fact 27-113 cm; and petiole length of the basal leaves is not up to 4 cm but may reach 11.3 cm.

Between the populations studied, significant differences were found in overall size, inflorescence length, number of flowers, and petiole length of basal leaves (Table 1). The basal leaves are conspicuously variable in size and shape (Fig. 2, below), being smallest in plants from serpentine where they have a cordate base, crenate margins, a well developed vascular system, a dense indumentum of long and short trichomes, and show an intense violet-reddish tinge. In plants collected on the other two substrata they are cuneate at the base, but weakly crenate, less conspicuously vascularized, and loosely covered with short trichomes only. The stem leaves (Fig. 2, above) show similar differences, being triangular in shape and crenate in plants from serpentine, ovate and sinuate in plants from limestone, and intermediate in plants growing on andesite. Seed coat ornamentation (Fig. 1, right) is of a deviating type in the serpentine population.

The anatomy of the analysed plants shows variation depending on the organs. Slight anatomical differences only were noted in root anatomy, but more significant ones were observed in stems and leaves. The plants from serpentine in particular deviate from the others in several respects. Their stem (Fig. 3-4) has weaker ridges, smaller epidermal cells wit a thicker cuticle, a more strongly developed sclerenchyma, and stronger vessels; whereas their leaves (Fig. 5) are covered by longer and more abundant trichomes, have smaller epidermal and mesophyll cells, and palisade cell layers both abaxially and adaxially.

The petiole of basal leaves (Fig. 4, right) is convex above in plants from serpentine and limestone, having two lateral vascular bundles in the former but 6-8 in the latter; it is concave above and has several vascular bundles laterally in plants from andesite.

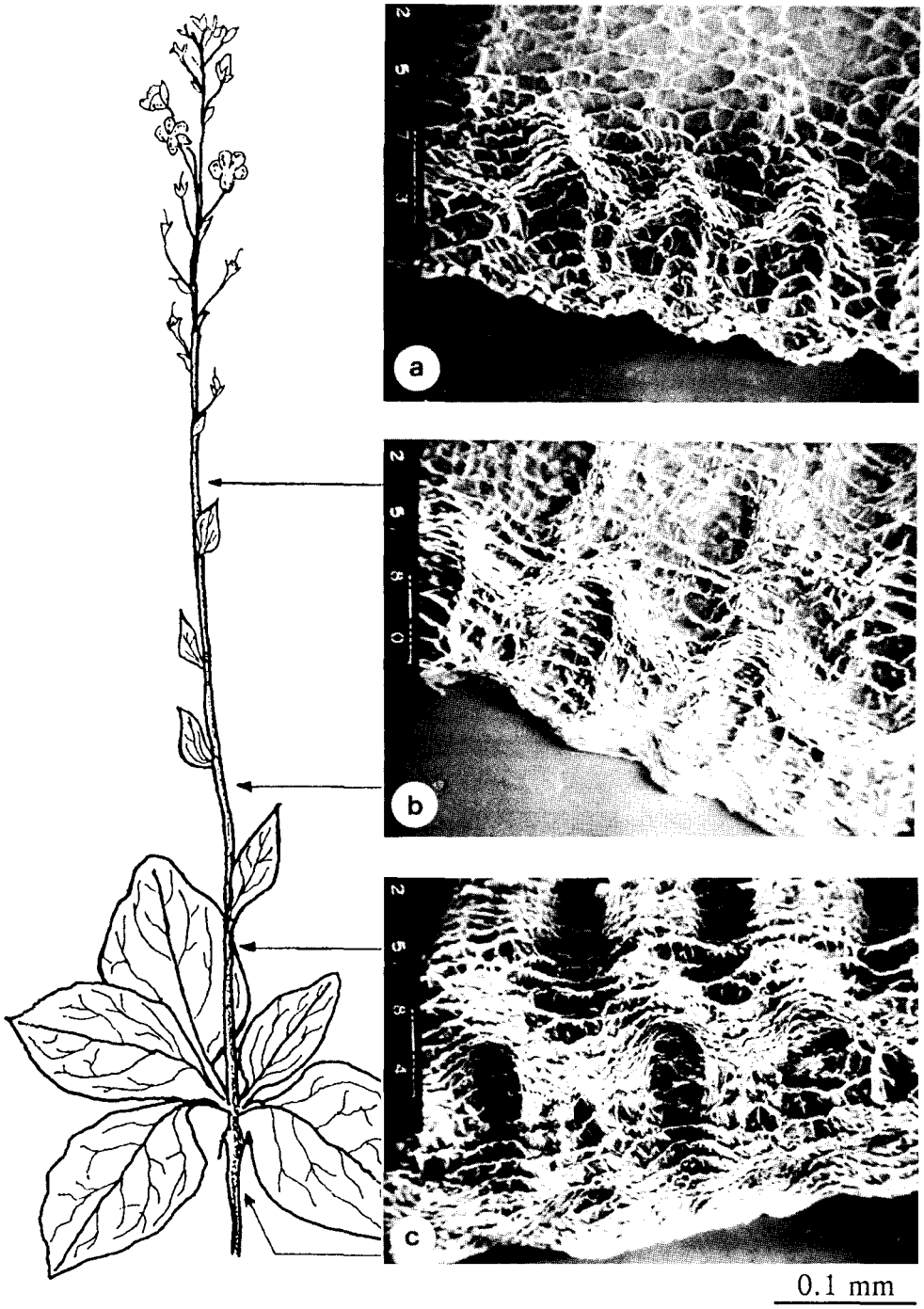

Fig. 1. *Verbascum phoeniceum*. – Left: plant habit, showing levels at which cross-sections were made (arrows). – Right: scanning electron micrographs, showing seed coat ornamentation (scale bar = 100 μm), of plants from serpentine (a), limestone (b), and andesite (c).

Conclusion

A comparative morphological and anatomical analysis of *Verbascum phoeniceum* plants from three habitats closely similar in climate, altitude and environmental conditions except for having different geological substrata (serpentine, andesite, limestone) has demonstrated clear differences. In particular, the specimens from serpentine showed the smallest average values in all quantitative morphological characters, those from limestone had the highest values, and those from andesite were intermediate but closer to the

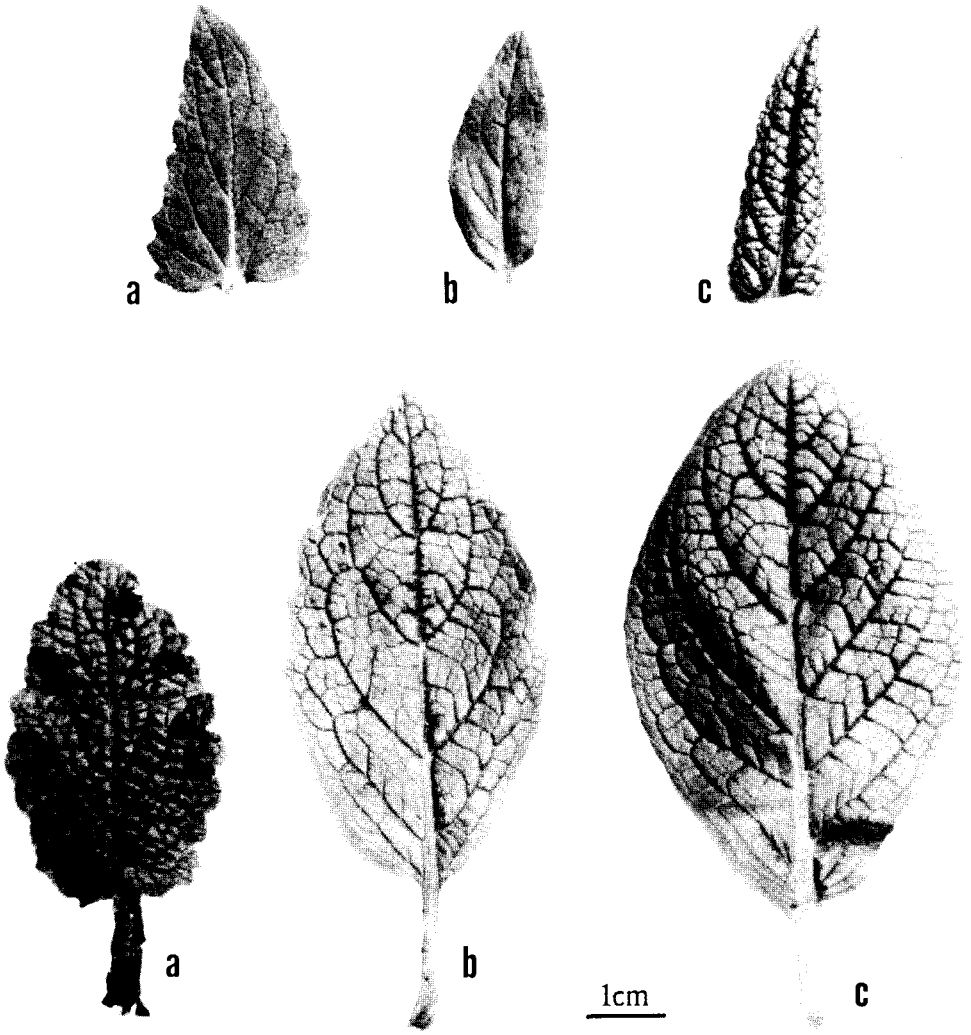

Fig. 2. *Verbascum phoeniceum,* basal leaves (below) and stem leaves (above) of plants from serpentine (a), limestone (b), and andesite (c). – Scale bar = 1 cm.

limestone population. Anatomical differences were noted in stem, leaves, and basal leaf petioles.

Former morphological and anatomical analyses had shown the influence of the geological substratum, especially serpentine, on plants, which may differ in many characters from those growing on other types of mother rock. Our present results suggest that such differences do occur in *Verbascum phoeniceum,* and will likely justify the recognition of separate, new taxa. Caryological and chemotaxonomical analyses, currently in progress, will allow to assess the appropriate rank of such taxa.

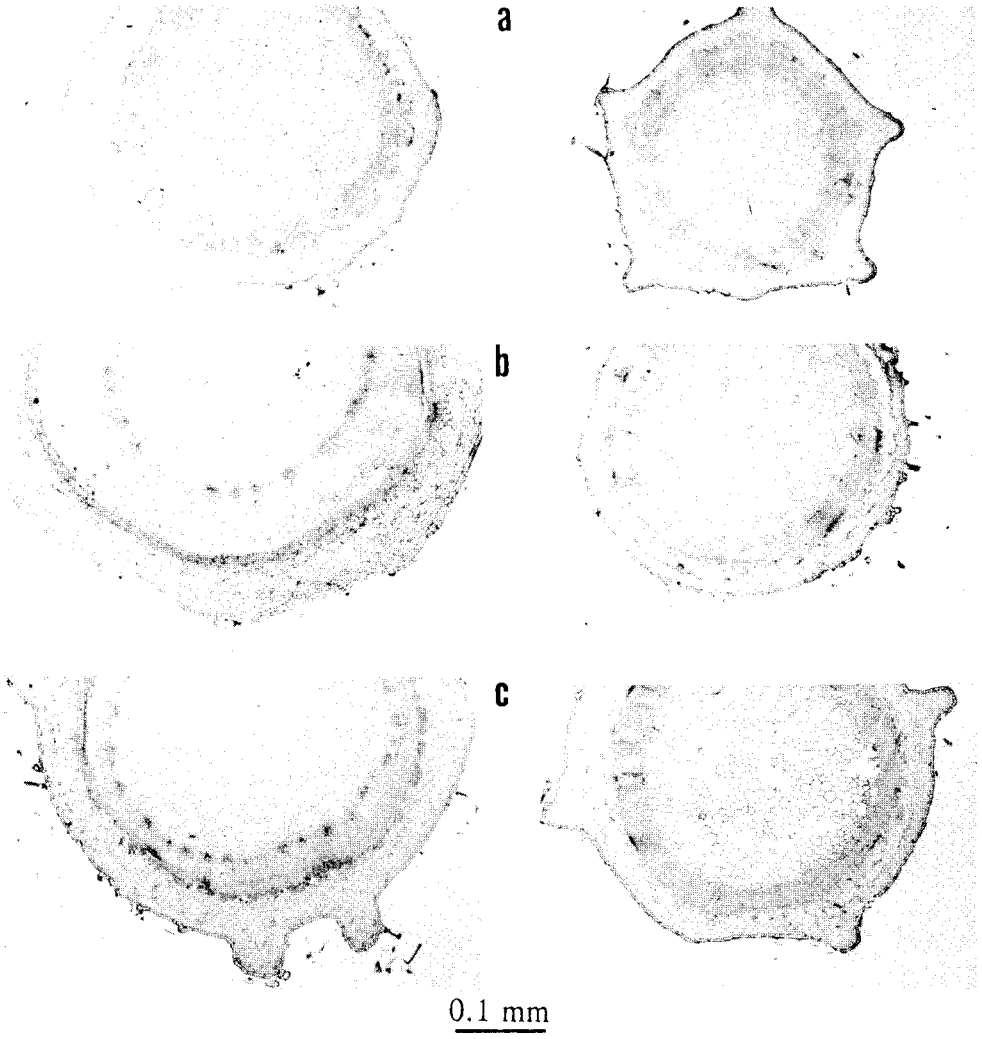

Fig. 3. *Verbascum phoeniceum,* stem cross-sections of plants from serpentine (a), limestone (b), and andesite (c); left: at the first (lowermost) internodium; right: at the second internodium. – Scale bar = 100 μm.

Acknowledgements

The authors are grateful to the Ministry of Science and Technology of Serbia for financial support of this study.

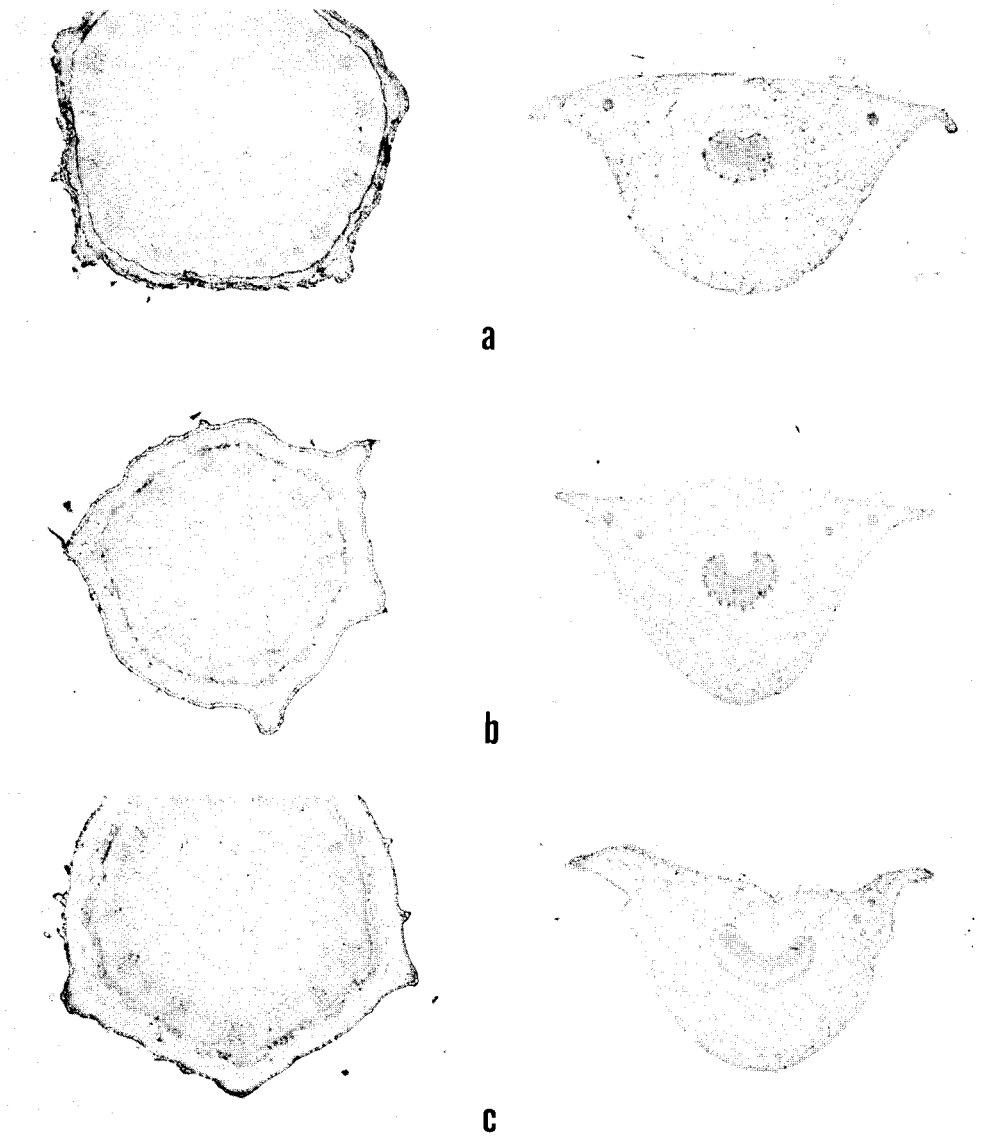

Fig. 4. *Verbascum phoeniceum,* cross-sections of stems at the uppermost internode below the inflorescence (left; scale bar = 100 μm) and of petioles of basal leaves (right; scale bar = 500 μm) of plants from serpentine (a), limestone (b), and andesite (c).

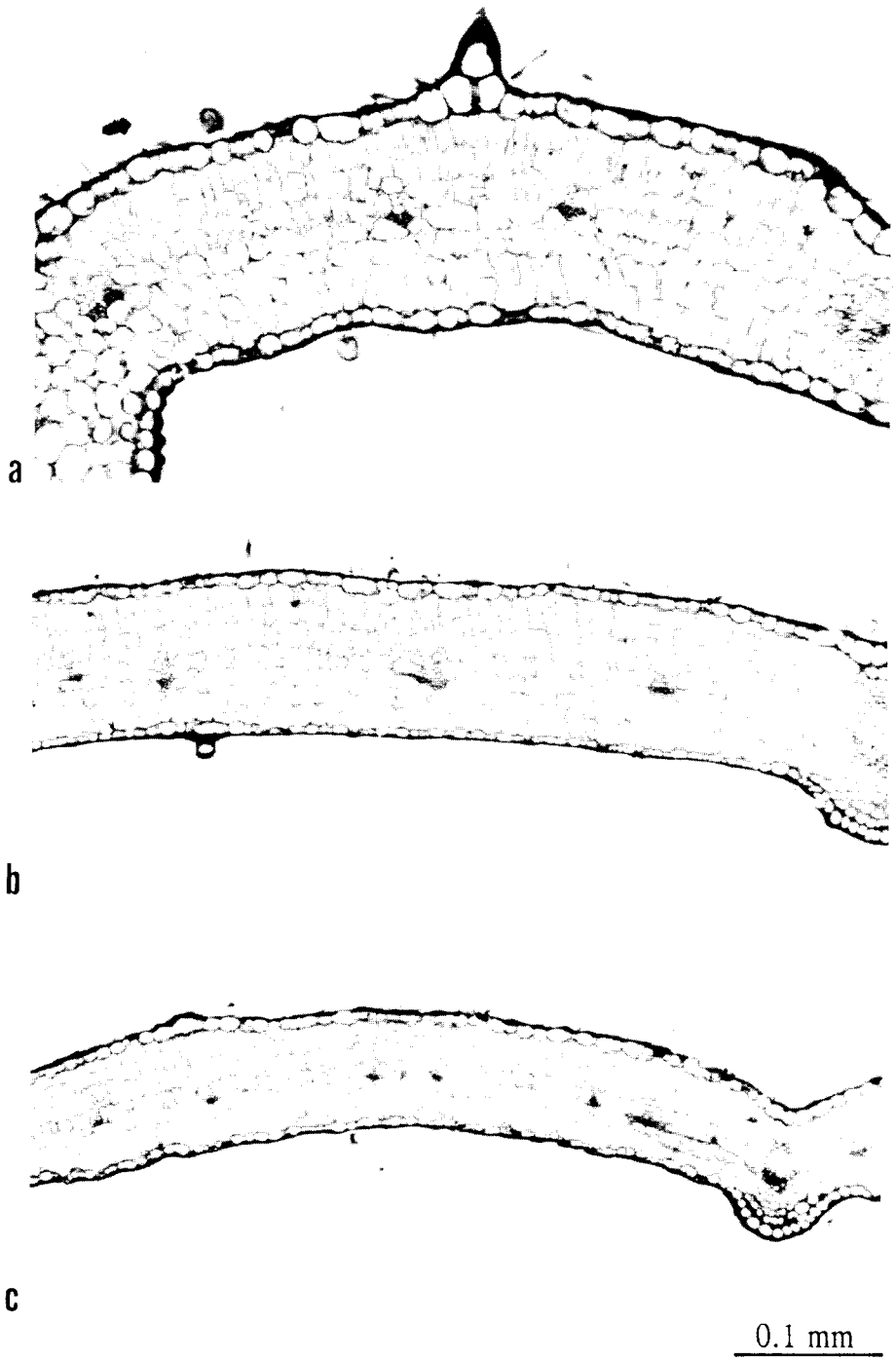

Fig. 5. *Verbascum phoeniceum*, cross-sections of stem leaves at the first node of plants from serpentine (a), limestone (b), and andesite (c). – Scale bar = 100 μm.

References

Ferguson, I. K. 1972: 7. *Verbascum* L. (incl. *Celsia* L.). – Pp. 205-216 in: Tutin, T. G., Heywood, V. H., Burges, N. A., Moore, D. M., Valentine, D. H., Walters, S. M. & Webb, D. A. (ed.): Flora europaea, **3.** – Cambridge.

Johansen, D. A. 1940: Plant microtechnique. – New York.

Nikolić, V. 1974: 1. Rod *Verbascum* L. – Pp. 101-142 in: Josifović, M. (ed.), Flora SR Srbije, **6.** – Beograd.

Pavlović, Z. 1962: Karakteristični elementi serpentinske flore Srbije. – Glasn. Prir. Muz. u Beogradu, Ser. B, Biol. Nauke **18:** 3-20.

Tatić, B., Veljović, V., Marković, A. & Petković, B. 1981: Prilog proučavanju serpentinske flore Jugoslavije. – Biosistematika **7:** 123-135.

Addresses of the authors:
B. Petković & B. Tatić, Botanical Institute and Garden, Faculty of Biology, University of Belgrade, Takovska 43, YU-11000 Beograd, Yugoslavia.
G. Đelić, Department of Biology, Faculty of Science, YU-34000 Kragujevac, Yugoslavia.