

A COMPARATIVE HISTOLOGICAL EXAMINATION OF THE LEAF EPIDERMIS OF SOME SOLANUM SPECIES

M. JUHÁSZ

Botanical Institute of the Attila József University,
Szeged

(Received September 1, 1968)

In my previous paper (J u h á s z, 1966) the leaf epidermis of some specimens of *Solanum* species were investigated, all of them being exposed to different environmental influences. After having valued the tissue marks of the leaf epidermis, we concluded that the quantitative tissue features of leaf are considerably influenced by ecological factors. The length and width of stomata resp. their ratio, the size, index and relative number of stomata have changed the least.

There arose the question whether the above-mentioned epidermal characteristics of different *Solanum* species grown in the same environment show differences considerable enough for separating, identifying the single species. Fifteen *Solanum* species were selected for being investigated. The taxonomical classification of the species examined, according to Bitter's system, is as follows (Hegi, 1927).

Genus: *Solanum* L.

I. Subgenus: *Archaeosolanum* Bitt.

1. *Solanum laciniatum* Ait.
2. *S. aviculare* Forst.
3. *S. aviculare* Forst. var. *albiflorum* Cheesem.
4. *S. simile* F. Muell.
5. *S. symonii* Hj. Eich.

II. Subgenus: *Eusolanum* Bitt.

a) sectio: *Morella* (Dun) Bitt.

6. *S. nigrum* L.
7. *S. alatum* Moench
8. *S. luteum* Mill.
9. *S. triflorum* Nutt.
10. *S. boerhavia* Thell.

b) sectio: *Dulcamara* (Dun) Bitt.

11. *S. dulcamara* L.

c) sectio: *Lycopersicum* (Dun. pro. gen.) Wettst.

12. *S. humboldtii* Willd.
 d) sectio: *Tuberarium* (Dun) Bitt.
 13. *S. chacoense* Bitt.
 III. Subgenus: *Leptostemum* (Dun) Bitt.
 Sectio: *Andromonoecium* Bitt.
 14. *S. sodomaeum* L.
 15. *S. giganteum* Jacq^u

The identification of the single species has been carried out on the basis of the fundamental works of De Candolle (1852), Bitter (1912), Baylis (1954, 1963), as well of the material of the *Solanum* collection of the National Botanical Collection in Budapest.

Material and method

The 15 *Solanum* species, selected for being investigated, have been grown in small plots of the experimental plantation of the Botanical Gardens in Szeged. The plants have developed here under identical conditions of soil, light and temperature. Their flowering took place in different times, according to the time of growing. Samples were always taken from the full-grown leaves in the middle region of the shoot of plants in flowering. The living leaves collected were fixed in Juel's mixture. From the middle part of the leaves fixed preparations were made by maceration, from both surfaces of the leaves. After being boiled in Schulze's macerating solution, and being rinsed, they were stained by Ehrlich's haematoxylin-vesuvin double-staining. The preparations, obtained in that way, were conserved in glycerin-gelatin. Then the following epidermal characteristics were measured: relative number, index, length, width and size of stomata. The number of the cells of leaf epidermis and of stomata was counted by projecting the preparations from the microscope. Length and width of stomata were measured by an ocularmicrometer. At every preparation, 30—30 fields of sight were measured 90—90 data per specimens, 270—270 data per species. The results were valuated with a mathematico-statistical method.

The frequency-curve of the data of measurements has shown a very normal dispersion and, thus, the variancy analysis has turned out to be the most suitable for valuations (Yule - Kendall, 1957).

In the course of the significancy examinations, the validity of our conclusions from the numerical data of the examinations was controlled by F- (Fisher) and t- (student) tests.

Results

The means of the 270—270 measurement data per plant species, as well the measurement results, compared and valuated by F- and t-tests, are published in the two Tables below. The stomatal numbers are given in sq.mm, referred to the field, and the stomatal length and width in μ (Tables I, II).

Discussion

Comparing the upper and lower surface epidermis of the same species, we find a very essential difference between the numbers of the

epidermal cells and stomata. On the lower surface there are a great many stomata, every stoma being surrounded by three-four small accessory cells, and so also the number of epidermal cells is higher. Also the higher stomatal index can be explained by that. On the epidermis of the upper surface the epidermal cells are large, here are but a

Table I. Epidermal data of the upper surfaces of leaves of *Solanum* species.

Names of plants	Stomatal number	Stomatal index	Stomatal length	Stomatal width	St. length St. width
<i>S. laciniatum</i> Ait.	43	4,5	32,73	22,57	1,319
<i>S. aviculare</i> Forst.	107	4,9	26,50	20,47	1,294
<i>S. aviculare</i> var. <i>albiflorum</i> Cheesem.	74	5,3	26,47	18,97	1,225
<i>S. simile</i> F. Muell	101	10,7	29,27	23,03	1,271
<i>S. symonii</i> Hj. Eich.	23	2,92	32,93	25,93	1,270
<i>S. nigrum</i> L.	45	10,97	36,23	25,80	1,468
<i>S. alatum</i> Moench.	100	16,95	33,83	19,90	1,714
<i>S. luteum</i> Mill.	49	10,54	36,43	24,20	1,502
<i>S. triflorum</i> Nutt.	160	19,83	24,77	20,00	1,237
<i>S. boerhavia</i> Thell.	102	21,30	34,30	23,57	1,457
<i>S. dulcamara</i> L.	33	3,47	24,43	19,71	1,290
<i>S. humboldtii</i> Willd.	-	-	-	-	-
<i>S. chacoense</i> Bitt.	24	6,37	28,43	21,57	1,354
<i>S. sodomaeum</i> L.	87	5,38	25,33	18,40	1,374
<i>S. giganteum</i> Jaqu.	12	0,66	25,67	19,40	1,321
F-test	84,25	352,2	50,63	49,27	49,62
LSD ₅ p.c.	15,11	1,12	2,01	1,16	0,056
LSD ₁ p.c.	21,98	1,64	2,93	1,70	0,82
LSD _{0,1} p.c.	33,03	2,46	4,40	2,55	1,23

few stomata, if any (e.g., *Solanum humboldtii* Willd). Size and forms of the stomata on both surfaces of the leaf approximately identical, thus the stomatal size is nearly the same, as well. Comparing the epidermal values of the single species with one another, we can observe that the epidermis of the species, belonging to the same subgenus or

section are very similar to each other, as to the qualitative and quantitative epidermal features. So the stomatal size, that is characteristic of the stomatal form, is only suitable for separating the subgenera; significant differences are not always shown by the stomatal number, either.

Table II. Epidermal data of the lower surfaces of leaves of *Solanum* species.

Names of plante	Stomatal number	Stomatal index	Stomatal length	Stomatal width	St. length St. width
<i>S. laciniatum</i> Ait.	221	14,07	33,13	23,67	1,386
<i>S. aviculare</i> Forst.	315	12,51	25,77	20,43	1,251
<i>S. aviculare</i> var. <i>albiflorum</i> Cheesem.	315	11,61	22,40	18,17	1,233
<i>S. simile</i> F. Muell	211	17,17	29,73	23,60	1,266
<i>S. symonii</i> Hj. Eich.	304	15,26	32,57	24,57	1,325
<i>S. nigrum</i> L.	189	20,75	33,33	23,67	1,449
<i>S. alatum</i> Moench.	209	19,54	32,53	20,50	1,708
<i>S. luteum</i> Mill.	201	19,24	33,63	23,27	1,426
<i>S. triflorum</i> Nutt.	207	18,76	26,20	19,73	1,329
<i>S. boerhavia</i> Thell.	168	23,00	34,67	23,40	1,480
<i>S. dulcamara</i> L.	287	16,21	24,33	18,53	1,303
<i>S. humboldtii</i> Willd.	210	14,37	25,97	18,73	1,386
<i>S. chacoense</i> Bitt.	219	24,74	27,37	20,80	1,316
<i>S. sodomaeum</i> L.	273	16,41	25,60	18,57	1,337
<i>S. giganteum</i> Jaqu.	279	17,10	23,63	18,73	1,260
F-test	16,44	151,19	72,02	44,94	75,75
LSD ₅ p.c.	37,57	0,98	1,65	1,14	0,045
LSD ₁ p.c.	54,70	1,42	2,40	1,65	0,065
LSD _{0,1} p.c.	82,1	2,14	3,61	2,49	0,099

The value the most characteristic of a species is the stomatal index that shows significant differences even inside a subgenus, on a 5 p.c. level of probability. However, the stomatal index and stomatal number respond sensitively to the influences of the external environment; they cannot be considered, therefore, to be a right reliable diagnostic mark. So, if the species of *Solanum* genus are identified on the basis of the leaf epidermis, even the measurable epidermal characteristics, examined by us and considered the most stable, are giving values characteristic of a species only if applied in a complex way.

Summary

We have collected leaf samples from the middle region of shoots of the specimens of fifteen *Solanum* species grown under identical ecological conditions in a small plot. Of the middle parts of leaves epidermal preparations of maceration were made and the following quantitative epidermal values measured: relative number, index, length, width and size of stomata. The results were valued with variance analysis.

It was ascertained that the upper and lower surface epidermis of the same species are differing considerably from each other, even in their quantitative characteristics. The greatest difference between the single species was observed concerning the value of the stomatal index while the stomatal size is a value characteristic of a certain subgenus.

References

- Baylis, G. T. S. (1954): Chromosome number and distribution of *Solanum aviculare* Forst. and *S. laciniatum* Ait. — Trans. Roy. Soc. New Zealand 82, 639—643.
- Baylis, G. T. S. (1954): A cytogenetical study of the *Solanum aviculare* species complex — Austral. Jo. Bot. 11, 168—177.
- Bitter, G. (1912): Solana nova minus cognita — VI. Feddes. Rep. Spec. Nov. 11, 461.
- De Candolle, A. P. (1852): Prodromus Systematis naturalis regni vegetabilis. — Paris, 13, 27—384.
- Hegi, G. (1927): Illustrierte Flora von Mittel-Europa. — München 5/4, 2583—2595.
- Juhász, M. (1966): Effect of ecological factors on the leaf epidermis of species *Solanum* — Acta Biol. Szeged, 12, 29—36.
- Yule, G. U. — Kendall, M. G. (1957): An introduction to the theory of statistics. — London.

Address of the author:

Dr. M. Juhász

Institute for Plant Morphology and Systematic
of the A. J. University, Szeged, Hungary