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František Starý and Jiřina Storchová-Burianová:

Solanum laciniatum AIT. in Europe

A Taxonomical Revision

Introduction

Solasodine is, besides diosgenine, the most important vegetable raw material for the production of steroid hormones. This aglycone of native glycoalkaloids such as solasonine, solamargine, solasodamine and solavilline is contained in some species of the genus *Solanum* as well as in both morphologically not much distinguishable New Zealand species: *Solanum aviculare* FORST. and *Solanum laciniatum* AIT.

One of these two species is being intensively introduced into field cultures of some European countries, and in the USSR it has been cultivated for several years on fairly large areas. Up to now, it has been generally considered as the species *Solanum aviculare* FORST. We have succeeded to prove, by means of karyological investigations of this material cultivated in Europe and by comparison of the same with both original New Zealand species as well as by means of comparative cultivation experiments that this is not the species *Solanum aviculare* FORST but the species *Solanum laciniatum* AIT. and, therefore, all data hitherto published in the European botanical as well as chemical literature must be corrected. The first tests with the cultivation of steroid-raw-material-giving plants were started in the Research Institute of Natural Drugs — Prague, in 1957. The starting material was represented among other plants by numerous genera of the *Solanaceae* family including the species indicated as *Solanum aviculare* FORST. imported from Hungary. Even foreign authors considered it as the above-mentioned species, e.g. GERASIMENKO et al., (1958), PEREPETSCHKO, (1958), BRINK, (1960), and they still believe it to be. The non-European authors, till the publication of the BAYLIS paper, (1954) considered the species *Solanum aviculare* as conspecific with the closely related and morphologically little distinguishable *Solanum laciniatum* (LAWRENCE, 1960). In older floras of New Zealand, Australian and Oceanian regions which are the original area of both mentioned species these are not accurately distinguished, and are stated once under one, then under the other name, e.g. HOOKER, (1864), MUELLER, (1887 et 1889), EWART, (1930), WEBB, (1948).

The idea of the taxonomic revision of this material was first suggested at our Institute in 1958 when karyological investigations were being carried out for the purpose of clearing the possibility of polyploidization as one of the ways of gaining a new, more efficient variety. At that time, it was ascertained that the number of chromosomes found did not correspond to the data in Chromosome Atlas (DARLINGTON, 1955, p. 305) which gives for *S. aviculare* the number $2n = 46$. Originally, we believed we had in hand a tetraploid type of the mentioned species, and in that sense, we formulated our findings

(Starý, Kybal, 1959; Štorchová in Milovidov, 1960, p. 207.) That happened because the original New Zealand material was not accessible to us. Regarding the number of chromosomes we ascertained corresponded to the closely related species *S. laciniatum*, we decided for a taxonomical revision of the whole European sortiment for we suspected, and rightly so as was proved later, that a taxonomical error had occurred. Therefore, we ordered original New Zealand material*) and, in 1960 and 1961 started comparative tests which are described in the following chapter.

Tests and Results

A. Karyology of the cultivated as well as original materials

Five samples from four European countries of probably the same origin were karyologically tested, and these were compared with four samples of the original New Zealand material. Roots taken from germinating seeds were fixed with Navashin mixture for 24 hours, dehydrated and mounted into paraffin. The microtome sections were 10—12 μ wide. Stained with ferric haematoxylin according to Heidenhain. Of all root tissues it was the periblem where most of the equatorial plates were found. In every series more than 20 chromosomal plates with the best distribution of chromosomes were investigated. The numbers of chromosomes were investigated. The numbers of chromosomes found are given in the following Table.

The numbers of chromosomes determined in the haploid phase proves in all five cases (1 to 5) that it is not *Solanum aviculare* as wrongly declared but

Tab. 1. The found number of chromosomes from the investigated samples of *Solanum aviculare* Forst. and *Solanum laciniatum* Ait.

Sample No.	Provenience	2n =
1	Czechoslovakia — Research Inst. for Natural Drugs, Praha Declared as: *S. aviculare*	92
2 and 3	USSR — Research Inst. for Medic. and Arom. Plants (VILAR), Moscow. Declared as: *S. aviculare*	92
4	German Demokratic Republic — Nematoda Research Station, Mühlhausen/Thüringen. Declared as: *S. aviculare*	92
5	Hungary — Research Inst. for Medicinal Plants (Gyógynävény Kutáto Int.), Budapest. Declared as: *S. aviculare*	92
6	New Zealand — Massey Agric. Coll., Palmerston North. Declared as: *S. aviculare*	46
7	Dtto Declared as: *S. laciniatum*	92
8	New Zealand — Botanic Garden, Christchurch. Declared as: *S. aviculare*	46
9	Dtto Declared as: *S. laciniatum*	92

*) We are indebted to Dr. H. Jacks from the Massey Agric. College, Palmerston North, for he first supply of seed specimens of both *Solanum* species.

Solanum laciniatum. In some plates with the numbers 2n = 92 the possibilities of being hyperploid chromosomes cannot be fully excluded. Contrary to BAYLIS, (1954) who introduces photographs of *Solanum laciniatum* and *Solanum aviculare* in their haploid phase from which he deduced the diploid number, we observed the diploid phase. In that respect, our figures are the first ones in the karyological iconography.

B. Cultivating Experiments

Seedlings of the material karyologically investigated were cultivated in the number 100 of each nine samples and planted into open hotbeds (May, 1960 and 1961). All plants were investigated in two following vegetation periods, i.e. in 1960 and 1961. Important differences were ascertained between the two species which were in correlation by their chromosome numbers.

1. There was a considerable difference in the phenology of both species, in our climatic conditions. While *Solanum laciniatum* (1 to 5, 7 and 9) set to flower already in July, and in September there was a good crop of ripening fruits, *Solanum aviculare* (6 and 8) set to flower towards the end of August and, in the first year (1960), had no fruit. The fruits were not formed till the second year of experiment (1961) on a few specimens which were kept in a hothouse throughout winter.

2. A statistically highly significant difference was ascertained in the morphological character of the axis. While the stem of *Solanum laciniatum* started branching at a height of 10 to 40 cm above the ground, the stem of *Solanum aviculare* did not branch until 50 to 110 cm above the ground. This made a distinct difference in the total plant habitus. *Solanum laciniatum* had the character of a widely spread bushy plant while *Solanum aviculare* was distinguished by its high and slim built. In plants of both species cultivated from cuttings these morphological phenomena were not so sharply distinguished as in those cultivated from seeds. Also the colouring of the axis differred in both species. While in *Solanum lacinatum* the axis was of a dark purple right from the bottom, the stem of *Solanum aviculare* was bright green at the bottom, and only the tips of the young twigs had a purplish tint.

3. At close examination, and by means of statistical investigation it is possible to determine a difference between both species in the morphology of flower parts. The main differences were found in the size, shape and colour of the corolla, in the size of pollen grains and in the sizes of fruits as well as in the presence of sclerenchyma bodies in the fruits of both species.

Solanum laciniatum has blue-purple blossoms, the corolla is round-shaped, 5—6 cm in diameter. *Solanum aviculare*, on the other hand, possesses blossoms of a lighter shade, the corolla is widely bell-shaped, occasionally, however, also round-shaped but smaller, 4 cm in diameter at maximum. In measuring the pollen grains it was ascertained *Solanum aviculare* were 24—30 μ dia while *Solanum laciniatum* ones were 35—40 μ. The average weight in 30 determinations of 1000 seeds of *Solanum laciniatum* was 1,02 g while in *Solanum aviculare* it amounted to 0,84 g. A substantial difference was ascertained in the size and number of sclerenchyma bodies in the fruits of both species. Stone cell masses in ripe fruit of *Solanum laciniatum* conspicuous, mostly as large as or larger than the seeds. By *S. aviculare* inconspicuous, only exceeding the seeds in size when coalescent. This data is totally in agreement with the paper by BAYLIS, (1954, p. 639).

4. In our experiment considerable differences were marked also in the size of the leaves in both species. A ratio opposite to what we expected was found. Namely, we ascertained that *S. laciniatum* was richer in the number of leaves but these were smaller than in *S. aviculare*. The sizes of stomata were, again, in correlation with the number of chromosomes, i.e. *S. laciniatum* possessed stomata larger by $^1/_3$ than *S. aviculare*. In view of the considerable variability ascertained in the leaf sizes of both species which could be caused even by virus diseases, we do not consider this feature as a distinguishing one.

Summary

By means of comparative karyology and cultivating tests the authors proved experimentally that the specific name of the *Solanum* cultivated in Europe is incorrect. It is the species *Solanum laciniatum* Ait. and not the species *Solanum aviculare* Forst. as has been, till now, wrongly assumed.

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Explanations of plate XVI

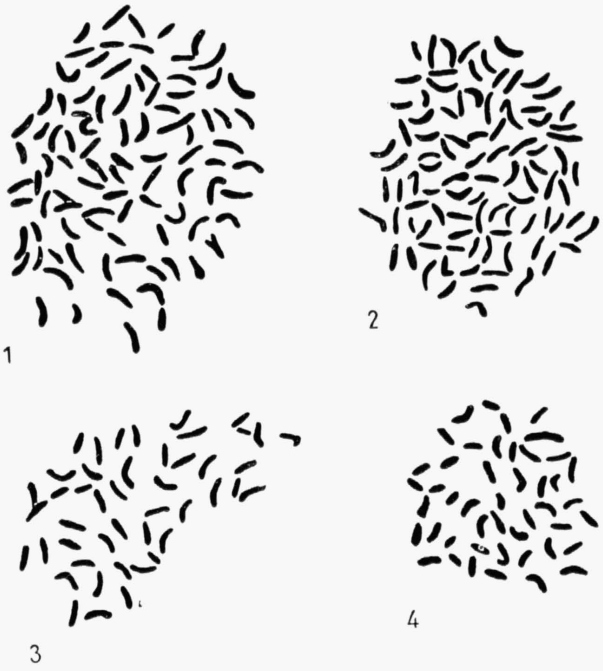
Idiogramms of the somatic metaphases from root tips *Solanum laciniatum* Ait. (1 and 2), 2n = 92 and *Solanum aviculare* Forst. (3 and 4), 2n = 46.

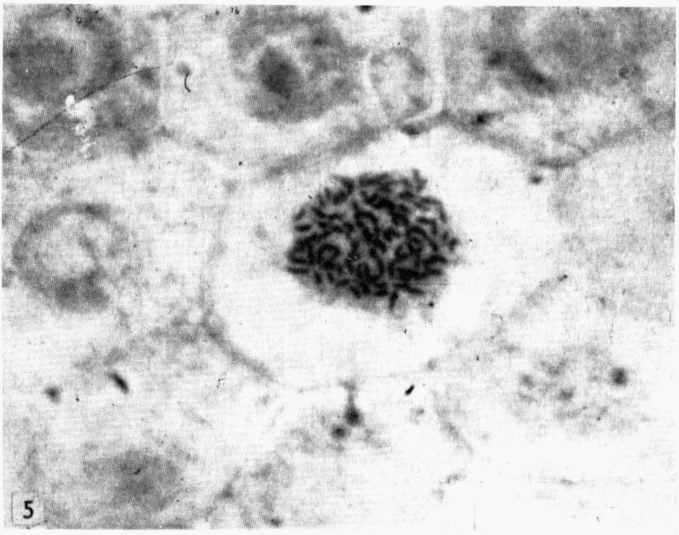
1 = a central axial cell of the plerome,

2 to 4 = peribleme cells.

Optics: Zeiss appochromate (90×), compens. ocul. HI (20×). Magnification: cca 3000 times. Drawing by means of Reichert device in the niveau of the microscope foot base.

5 = somatic metaphase from peribleme cell of *Solanum laciniatum* Ait. root tip. 2n = 92; microphoto, magnif. cca 1000 times.





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