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CONTRIBUTIONS TO THE KNOWLEDGE OF THE GENUS *STAURODESMUS* TEILING (ORD. DESMIDIALES) IN ROMANIA

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Abstract: Contributions to the knowledge of the genus *Staurodesmus* Teiling (ord. Desmidiaceae) in Romania. The paper presents some preliminary data regarding the study of the genus *Staurodesmus* Teiling (ord. Desmidiaceae) in Romania. 14 species of the genus have been recorded in Romania and 30 morphological characters were selected for numerical taxonomic analysis of *Staurodesmus* taxa. They are briefly characterized as concerning their morphology, ecology and distribution in Romania.

Keywords: Conjugatophyceae, desmids, *Staurodesmus*, morphology, Romanian distribution, numerical taxonomy, phenogram

Introduction

Desmids are attractive unicellular microscopic forms of conjugating green algae, occurring only in freshwaters. They are usually divided into two families based on the structure of the cell wall. The Mesotaeniaceae having a homogeneous wall lacking pores are known informally as the “saccoderm desmids”, while the Desmidiaceae, such as *Staurodesmus*, having porous, two-halves wall of different ages and origin, that are typically separated by a narrow isthmus are known as the “placoderm desmids”. The desmid name was given to the latter group, from the Greek word “desmos” meaning “bond”.

The relationships of the family and genera within the conjugating green algae have experienced a series of bewildering rearrangements. Some authors preferred to group all conjugating green algae within one order Zygnematales. However, placoderm desmids are often treated as members of the order Desmidiaceae, while the Zygnemataceae and Mesotaeniaceae are classified separately in the Zygnematales. Whether one or two orders are used, the conjugating green algae are considered either members of a monophyletic group within the class Charophyceae (*sensu* Wattox and Stewart, 1984) or as members of a separate class the Zygnemophyceae [6].

The genus *Staurodesmus* (gr. *stauron* – cross, *desmos* – bond) was established by Teiling (1948) by fusing parts of the genera *Arthrodesmus* Ehr. ex Ralfs and *Staurastrum* Meyen. Species of *Staurodesmus* are marked by smooth-walled semicells which in apical view are bi- to pluriradiate, and furnished with one single papilla, mucro or spine per radius. The cell wall is smooth, but exhibits characteristically disposed punctae excreting mucilage (sometimes visible as distinct plugs) which are typical for some species. The cell walls are never ornamented by granules, and spines occur only at the angles.

Staurodesmus usually occurs in the plankton or metaphyton of acidic, oligotrophic and dystrophic lakes, ponds and bogs, but some of its species can live in mesotrophic or even eutrophic water bodies.

Materials and Method

In order to identify and properly describe the Romanian *Staurodesmus* species, algal samples were collected from different locations during 2005. The most prolific sampling sites were those sampled during July-October from the Călățele Pădure, Beliș, Dealu Negru peat bogs (Romanian Western Mountains) and from different ponds and bogs situated in Mestecănișul de la Reci Nature Reserve (Covasna county). To make a synthesis of the distribution of the genus in Romania bibliographic sources were used as well [1, 4, 7-18]. The present taxonomic investigation was based on the descriptions of previously recorded taxa, included in the key books and recent monographs widely used in similar investigation [2, 3, 5, 20].

A total of 30 morphological characters concerning semicell shape and size, position and length of the spines, features of the sinus and isthmus were used for numerical taxonomic analysis of the 14 *Staurodesmus* species [19]. The data matrix obtained was searched for structure by cluster analyses. Similarity index of Jaccard was employed and phenogram was constructed running the statistical program PAST.

Results and Discussion

The present paper presents the morphological description, ecology and distribution of 14 species occurring in Romania. In “*The Algae of Romania*”, Cărăuș [1] listed 16 *Staurodesmus* taxa found in Romania, but among these *S. apiculatus* and *S. joshue* are varieties of the species *S. dejectus*, respectively *S. extensus*.

1. *Staurodesmus convergens* (Ehr. ex Ralfs) Lillieroth

Cells biradiate, sinus acute, widely open. Semicells elliptic, angles bearing a downward-curved spine, often stout and following the contour of the apex. Wall faintly punctuate.

L: 33-54μm, l: 40-60μm

Ecology: oligo- to eutrophic

Distribution in Romania: Cluj county: Tăul cu Mesteceni (Sălicea) – transition bog, Tăul Mare (Sălicea) – bog, Tăul Măgurii (Sălicea) – bog, Tăul cu Arini (Sălicea) – eutrophic pond, Tăul cu Botele (Sălicea) – eutrophic pond, Dîmbul Negru area – peat bog, Valea Călinesei – wetland, Molhașul de la Calul de Piatră – raised peat bog, Călățele Pădure – *Sphagnum* peat bog

2. *Staurodesmus cuspidatus* (Bréb. ex Ralfs) Teiling

Cells bi- to pentaradiate, the base of the semicell elongated to form a short, cylindrical isthmus. Semicells triangular to fusiform, angles attenuated into parallel or divergent spines.

L: 19-35μm, l: 17-32μm

Ecology: meso-eutrophic

Distribution in Romania: Cluj county: Pond of the Central Park Cluj-Napoca
Covasna county: Mestecănișul de la Reci Nature Reserve: peat bogs, pools

3. *Staurodesmus dejectus* (Bréb. ex Ralfs) Teiling var. *dejectus* Teiling

Cells tri- to tetra-radiate, sinus open and rounded. Semicells cup-shaped with divergent, rarely vertical short spines, isthmus slightly elongate, apex slightly convex.

L: 24-40μm, l: 19-36μm

Ecology: oligo- mesotrophic

Distribution in Romania: Hunedoara county (Retezat Mts. National Park): Mlaștina Mare sub Muchia Ascuțită – *Sphagnum* peat bog, Zănoaga – litoral boggy area, Tăul Urât – wetland, Valea Judelui Zănoaga – peat bog, Gemenele – glacial lake, Bucura – glacial lake
Maramureș county: Hoteni - peat bogs.

Staurodesmus dejectus (Bréb. ex. Ralfs) Teiling var. *apiculatus* (Bréb.) Teiling

Cells smaller than of the type variety having minute spines.

Distribution in Romania: Cluj county: Tăul cu Mesteceni (Sălicea) – transition bog
Tăul Măgurii (Sălicea) – bog

Hunedoara county (Retezat Mts. National Park): Mlaștina Mare sub Muchia Ascuțită –
Sphagnum peat bog

4. *Staurodesmus dickiei* (Ralfs) Lillieroth var. *dickiei* West

Cells tri- or rarely tetradial, sinus acute. Semicells oval with attenuated corners bearing a spine of moderate length and curved downwards. Punctae with mucilage often apparent over semicell surface.

L: 20-46 μ m, l: 42-50 μ m

Ecology: oligo-mesotrophic to eu-mesotrophic

Distribution in Romania: Cluj county: Tăul cu Mesteceni (Sălicea) – transition bog, Tăul Mare (Sălicea) – transition bog, Tăul Măgurii (Sălicea) – bog, Tăul cu Arini (Sălicea) – eutrophic pond, Tăul cu Botele (Sălicea) – eutrophic pond, Dîmbul Negru – peat bog, Tăul fără Fund (Padiș Plateau) – *Sphagnum* peat bog, Valea Izbuului – raised peat bog, Călățele Pădure – *Sphagnum* peat bog

Tulcea county: Delta Dunării – lakes and wetlands

Staurodesmus dickiei (Ralfs) Lillieroth var. *rhomboides* (W. & G. S. West) Lillieroth

Cells rhomboidal, apex often flattened and spines strongly recurved.

L: 37-40, l: 42-50 μ m

Ecology: meso-eutrophic

Distribution in Romania: Cluj county: Tăul cu Mesteceni (Sălicea) – transition bog

5. *Staurodesmus extensus* (Borge) Teiling var. *extensus* Teiling

Cells biradiate. Semicells trapezoid, spines divergent, apex slightly concave or straight, sinus widely open, isthmus cylindrical.

L: 17-31 μ m, l: 13-21 μ m

Ecology: oligo-mesotrophic

Distribution in Romania: Cluj county: Tăul cu Mesteceni (Sălicea) – transition bog, Tăul Mare (Sălicea) – transition bog, Tăul Măgurii (Sălicea) – bog, Molhașul de la Calul de Piatră – raised peat bog

Staurodesmus extensus (Borge) Teiling var. *joshuae* (Gutw.) Teiling

Cells with larger parallel spines.

L: 18-22 μ m, l: 14-22 μ m

Distribution in Romania: Cluj county: Tăul cu Mesteceni (Sălicea) – transition bog

6. *Staurodesmus glaber* ([Ehr.] ex Ralfs) Teiling

Cells bi- to tetradial, sinus acute or slightly rounded. Semicells triangular, sides and apex slightly convex, angles with short convergent spines.

L: 15-33 μ m, l: 13-25 μ m

Ecology: oligo-mesotrophic to eutrophic

Distribution in Romania: Cluj county: Tăul cu Mesteceni (Sălicea) – transition bog, Tăul Măgurii (Sălicea) – bog, Tăul cu Botele (Sălicea) – eutrophic pond, Tăul Mare (Sălicea) – bog, Dîmbul Negru area – peat-bog, Molhașul dintre Izbuce – raised peat bogs, Valea Călinesei – wetland, Tinovul „La Mlaștina” (Călineasa) – peat bog, Valea Vadului (Gura Vadului area) – *Sphagnum* peat bog

Hunedoara county (Retezat Mts. National Park): Mlaștina Mare sub Muchia Ascuțită – *Sphagnum* peat bog, Zănoaga – litoral boggy area, Tăul Porții – peat boggy area, Tăul Ștevei – peat boggy area, Tăul Zănoașii – *Sphagnum* peat bog, Bucura – peat boggy area, Valea Judelui Zănoaga – peat bog, Mlaștina de pe Platoul Șeselor – peat bog, Tăul Urât – wetland
Covasna county: Mestecănișul de la Reci Nature Reserve – peat bogs, pools

7. *Staurodesmus incus* (Ehr.) Teiling

Semicells triangular, apex straight with slightly convex sides, spines stout, long and divergent, isthmus elongated.

L: 19- 27 μm, l: 16-22 μm

Ecology: oligo-mesotrophic

Distribution in Romania: Cluj county: Tăul Măgurii (Sălicea) – bog, Tăul fără Fund (Padiș plateau) – *Sphagnum* pond, Padiș – Bălăleasa – *Sphagnum* peat bog, Valea Izbuclui – raised peat bogs, Valea Ponorului – wetland, Molhașul Mare de la Izbuclui – raised peat bog, Valea Călinesei – wetland, Molhașul de la Calul de Piatră – raised peat bog

Hunedoara county (Retezat Mts. National Park): Mlaștina Mare sub Muchia Ascuțită – *Sphagnum* peat bog, Zănoaga – litoral boggy area, Lia – litoral boggy area, Tăul Știrbului – peat boggy area, Tăul Ștevei – peat boggy area, Valea Judelui Zănoaga – peat bog, Gemenele – glacial lake, Tăul Zănoașii – *Sphagnum* peat bog, Tăul Urât – wetland, Tăul Negru – Tăurile Cârlișului – peat bogs

Maramureș county: Tăul Cendroiu – oligotrophic peat bog

8. *Staurodesmus indentatus* (W. & G. S. West) Teiling f. *indentatus*

Cells bi- to triradiate. Semicells subrectangular towards the apex and cup-shaped in the region of the isthmus, the two parts bulging slightly outwards, spines mostly long and divergent or parallel, rarely convergent. Cells often with distinct mucilage pores.

L: 20-44 μm, l: 18-28 μm

Ecology: oligo-mesotrophic

Distribution in Romania: Cluj county: Tăul cu Mesteceni (Sălicea) – transition bog, Tăul Mare (Sălicea) – bog, Tăul Măgurii (Sălicea) – bog, Valea Ponorului – wetland, Valea Călinesei – wetland, Molhașul dintre Izbuclui – raised peat bogs

Staurodesmus indentatus (W. & G.S.West) Teiling f. *brevispinosus* Teiling

Distribution in Romania: Cluj county: Tăul cu Mesteceni (Sălicea) – transition bog, Tăul Mare (Sălicea) – bog, Tăul Măgurii (Sălicea) – bog

9. *Staurodesmus mucronatus* (Ralfs ex Bréb.) Croasdale

Cells usually triradiate. Semicells ellipsoid bearing a rather short, horizontal or slightly upwards projected spine at each of the poles.

L: 17-29 μm, l: 18-36 μm

Ecology: oligotrophic

Distribution in Romania: Cluj county: Tăul cu Mesteceni (Sălicea) – transition bog, Călățele Pădure – *Sphagnum* peat bog

10. *Staurodesmus patens* (Nordst.) Teiling

Cells triradiate (rarely tetraradiate). Semicells cup-shaped, sinus acute, apex slightly convex, spines short, divergent.

L: 16-26(-35) μm, l: 16-25(-30) μm

Distribution in Romania: Cluj county: Tăul cu Botele (Sălicea) – eutrophic pond

11. *Staurodesmus pterosporus* (Lund.) Bourrelly

Cells triradiate. Semicells cup-shaped, isthmus large, apex flat and spines divergent.

L: 10-16 μm , l: 10-16 μm

Ecology: oligo-mesotrophic to eutrophic

Distribution in Romania: Cluj county: Tăul cu Mesteceni (Sălicea) – transition bog, Tăul Mare (Sălicea) – bog, Tăul Măgurii (Sălicea) – bog, Tăul cu Arini (Sălicea) – eutrophic pond, Valea Izbuului – raised peat bogs, Molhașul de la Izbu – raised peat bogs, Tinovul „La Mlaștina” (Călineasa) – *Sphagnum* peat bog, Valea Călinesei – wetland

Covasna county: Mestecănișul de la Reci Nature Reserve – peat bogs, pools

12. *Staurodesmus spencerianus* (Nordst.) Teiling

Cells usually triradiate, sinus open and acute. Semicells triangular, sides and apex slightly convex, spines long, divergent.

L: 17-40 μm , l: 16-30 μm

Ecology: oligotrophic

Distribution in Romania: Cluj county: Valea Ponorului – wetland, Tăul Mluhii – *Sphagnum* peat bog, Tinovul „La Mlaștina” (Călineasa) – *Sphagnum* peat bog, Valea Călinesei – wetland

Covasna county: Mestecănișul de la Reci Nature Reserve – peat bogs, pools

13. *Staurodesmus spetsbergensis* (Nordst.) Teiling

Cells tri- to tetra-radiate. Semicells oval-elliptic with convex apex and a very short papilla at each angle, acute widely open sinus, cell wall smooth or finely punctate.

L: 34-42 μm , l: 31-41 μm

Ecology: meso-eutrophic

Distribution in Romania: Cluj county: Tăul cu Mesteceni (Sălicea) – transition bog, Tăul Mare (Sălicea) – bog, Tăul Măgurii (Sălicea) – bog, Tăul cu Botele (Sălicea) – eutrophic pond

14. *Staurodesmus triangularis* (Lagerh.) Teiling

Cells usually biradiate. Semicells triangular, apex slightly convex, isthmus elongated, sinus opening widely, spines parallel and long.

L: 14-40 μm , l: 19-34 μm

Ecology: oligotrophic

Distribution in Romania: Cluj county: Molhașul de la Calulul de Piatră – raised peat bog

Bihar county: Valea Iadului Râmeți – peat bog, wetlands, Stâna de Vale area – peat bogs

For the numerical taxonomy 30 morphological characters were chosen. The arguments of choice were: availability for all the taxa, absence of redundancy, clear definition of the states of characters and the stability of these states at a taxonomic level. All these phenetic characters were treated of equal value (Adansonian weighting).

The *Staurodesmus* taxa dealt with in this study, according to Teiling [20] are divided in to the following groups: The *sibiricus* group: *S. spetsbergensis*; The *incus* group: *S. incus*, *S. extensus*; The *triangularis* group: *S. triangularis*, *S. indentatus*; The *dejectus* group: *S. dejectus*; The *cuspidatus* group: *S. cuspidatus*; The *connatus* group: *S. patens*, *S. pterosporus*; The *megacanthus* group: *S. spencerianus*, *S. glaber*; The *mucronatus* group: *S. mucronatus*; The *convergens* group: *S. convergens*; The *Dickiei* group: *S. dickiei*.

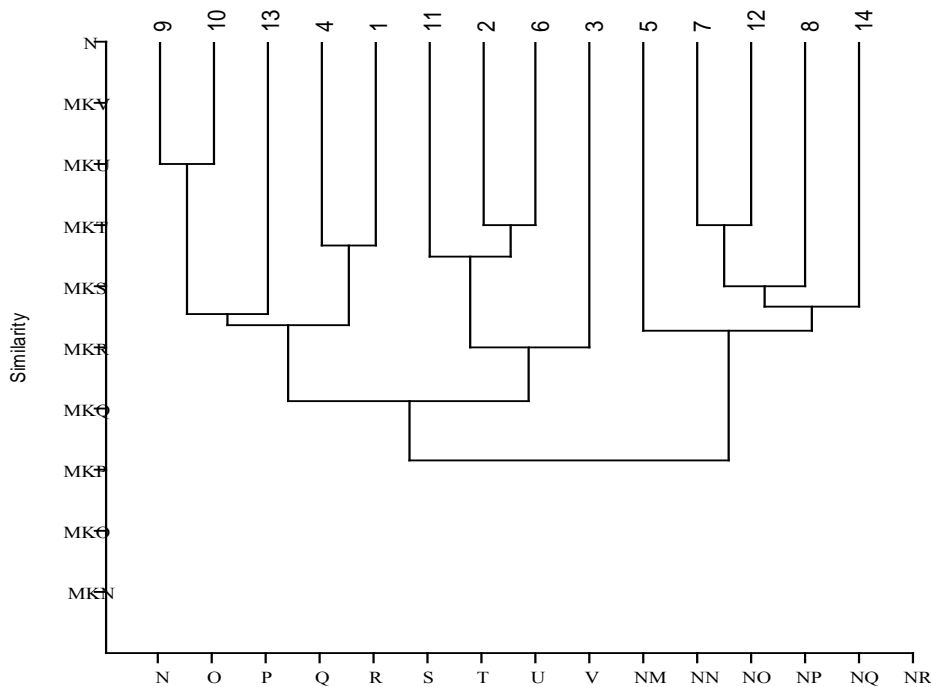


Fig. 1: Phenogram representing the grouping of *Staurodesmus* species (OTUs), based on phenetic similarity (1 – *S. convergens*, 2 – *S. cuspidatus*, 3 – *S. dejectus*, 4 – *S. dickiei*, 5 – *S. extensus*, 6 – *S. glaber*, 7 – *S. incus*, 8 – *S. indentatus*, 9 – *S. mucronatus*, 10 – *S. patens*, 11 – *S. pterosporus*, 12 – *S. spencerianus*, 13 – *S. spetsbergensis*, 14 – *S. triangularis*)

The phenogram (Fig. 1) shows the clustering of the 14 operational taxonomic units (OTUs) based on the degree of phenetic similarity. According to this phenogram there are 3 major clusters joining at the phenon levels of about 50%. The distribution of taxa among the clusters is as follows: *S. convergens*, *S. dickiei*, *S. mucronatus*, *S. patens* and *S. spetsbergensis* are in cluster 1; *S. cuspidatus*, *S. dejectus*, *S. glaber* and *S. pterosporus* are in cluster 2; *S. extensus*, *S. incus*, *S. indentatus*, *S. spencerianus*, *S. triangularis* are in cluster 3. These three major aggregates may be considered as sections and consist of smaller aggregates reflecting the groups established by Teiling that may be taken series. There are some contradictions between these two classifications: *S. spencerianus* is positioned close to *S. incus* whereas *S. glaber* is far from this group, and apparently more similar to *S. cuspidatus*.

Conclusions

It seems that the selected characters reflect the taxonomic relationships of the species. The classification obtained by numerical taxonomy gave more information than the conventional one regarding the relationship between the *Staurodesmus* species dealt with in the present study. The results are by no means revolutionary but do encourage future revision of the traditional views.

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CONTRIBUȚII LA CUNOAȘTEREA GENULUI *STAURODESMUS* TEILING (ORD. DESMIDIALES) ÎN ROMÂNIA

(Rezumat)

Genul *Staurodesmus* este reprezentat în România prin 14 specii: *S. convergens*, *S. cuspidatus*, *S. dejectus*, *S. dickiei*, *S. extensus*, *S. glaber*, *S. incus*, *S. indentatus*, *S. mucronatus*, *S. patens*, *S. pterosporus*, *S. spencerianus*, *S. spetsbergensis*, *S. triangularis*. Materialul utilizat la descrierea speciilor a fost colectat în cursul anului 2005, din diverse locații însă cele mai prolifiche prelevări s-au dovedit a fi cele din: iulie-octombrie din mlaștinile de turbă de la Călățele Pădure, Dealu Negru, Beliș (jud. Cluj), respectiv octombrie din diverse zone umede de la Mestecănișul de la Reci (jud. Covasna). Pentru fiecare specie am realizat: descrierea morfologică, cu precizarea dimensiunilor pe baza propriilor observații și a literaturii de specialitate, precum și răspândirea speciilor în România, pornind de la baza de date *The algae of Romania* – I. Cărauș, 2002, și a articolelor publicate între timp.

În vederea realizării unei analize numerice a gradului de similaritate fenotipică a speciilor genului am selectat 30 de caractere morfologice gupate în 10 categorii: lungimea spinilor, poziția spinilor, forma semicelulei, dimensiunile semicelulei, deschiderea sinusului, vârful sinusului, aspectul istmului, numărul de radiații, suprafața celulară, marginile apexului celular privite apical. Din analiza fenogramei realizate se constată guparea celor 14 specii în 3 grupuri fenetice formate la un nivel de similaritate de aprox. 50%. Acest fapt nu este în contradicție cu schema de clasificare propusă de către Teiling, însă ne oferă informații utile cu privire la nivelul de similaritate existent între diversele grupuri, în vederea unei eventuale restructurări a clasificării infragenerice.