

***Asterosiphon dichotomus* (Kützing) Rieth (Vaucheriales, Ochrophyta, Xanthophyceae) in sub-arid agricultural soils of Catalonia (Spain)**

***Asterosiphon dichotomus* (Kützing) Rieth (Vaucheriales, Ochrophyta, Xanthophyceae) en suelos sub-áridos de Cataluña (España)**

JAUME CAMBRA-SÁNCHEZ

Departamento de Biología Vegetal, Facultad de Biología, Universidad de Barcelona, Av. Diagonal 645, 08028 Barcelona, España.
jcambra@ub.edu

RESUMEN

En una campaña de muestreo en la provincia Lleida (Cataluña, España), se han recolectado diversas algas edáficas en campos agrícolas. En una de las localidades estudiadas se encontró *Asterosiphon dichotomus* (Kützing) Rieth (Vaucheriales, Ochrophyta, Xanthophyceae), y es la primera vez que se observa este taxón para la flora algológica ibérica. Las algas crecían sobre suelos húmedos, en plantaciones de almendros. Se describe su morfología y su crecimiento en cultivos, y se analiza su distribución geográfica en Europa.

A botanical survey was performed in the Lleida sub-arid agricultural soils (Catalonia, Spain) during 1995-96. In this study the edaphic alga *Asterosiphon dichotomus* (Kützing) Rieth (Vaucheriales, Ochrophyta, Xanthophyceae) appeared abundantly between *Botrydium* sp. vesicles. The genus *Asterosiphon* is very close to *Vaucheria*. Macroscopically, it forms green rosettes of 5-20 mm in diameter and it is organised in plurinucleated filaments (siphonal-siphonocladal organization), with a conspicuous dichotomous branching system, the branches of which usually are radially arranged. The reproduction is asexual, by the formation of akinetes in rows at the end of the filaments.

Asterosiphon dichotomus was firstly described by Kützing (1841) as *Protonema dichotomum* Kützing and later as *Gongrosira dichotoma* Kützing. However, Dangeard (1940) suggested that this taxon did not belong to the genus *Vaucheria*, *Protonema* or *Gongrosira*, based on the growth morphology and the reproduction type. Dangeard (1940) thus created a new genus: *Asterosiphon*. Later, Dangeard (1942) gave more data about the biology of *Asterosiphon*, using the combination *A. terrestre* Dangeard. Finally, Rieth (1962) cultured *Asterosiphon*, giving more information about the akinete ontogeny and germination. Moreover, Rieth (1962) proposed the new combination *Asterosiphon dichotomus* (Kützing) Rieth. After Rieth (1962, 1980), the asexual life cycle of this alga

is well known. It forms a vegetative haploid thallus which is attached to the soil by a long colourless rhizoid. The green filaments can form rows of akinetes in dichotomous branched filaments and this shape was called "*Gongrosira-stadium*".

The algae were collected by hand between October 1995 and February of 1996. In both cases after rain. They were growing in fields of almond trees in Torregrossa (Catalonia, Spain), which is located in a sub-arid mediterranean region. In Torregrossa, the climate is mediterranean, with an average precipitation of 351.7 mm/year. The average temperature is 14.8°C. There is little precipitation except in spring and autumn. The material is preserved in the BCN-Phyc.

The microscopic study was performed with a Nikon Labophot-2 light microscope. The *Asterosiphon* samples were washed in distilled-sterilised water and transferred to a WoodsHole (WC) medium (Guillard 1975) agarized culture medium in Petri dishes. The culture conditions were 2000 lux, 12h:12h photoperiod and a temperature of about 18°C. The culture was checked daily. To improve the growth rate, 2-3 ml of liquid WoodsHole media was added to the cultures after the first week. This procedure stimulated the growth of the *Asterosiphon* thallus.

The thalli were round, about 5-20 mm in diameter, with conspicuous radially arranged filaments (Fig. 1 A, B). The main branches were 42-48 µm in diameter, forming

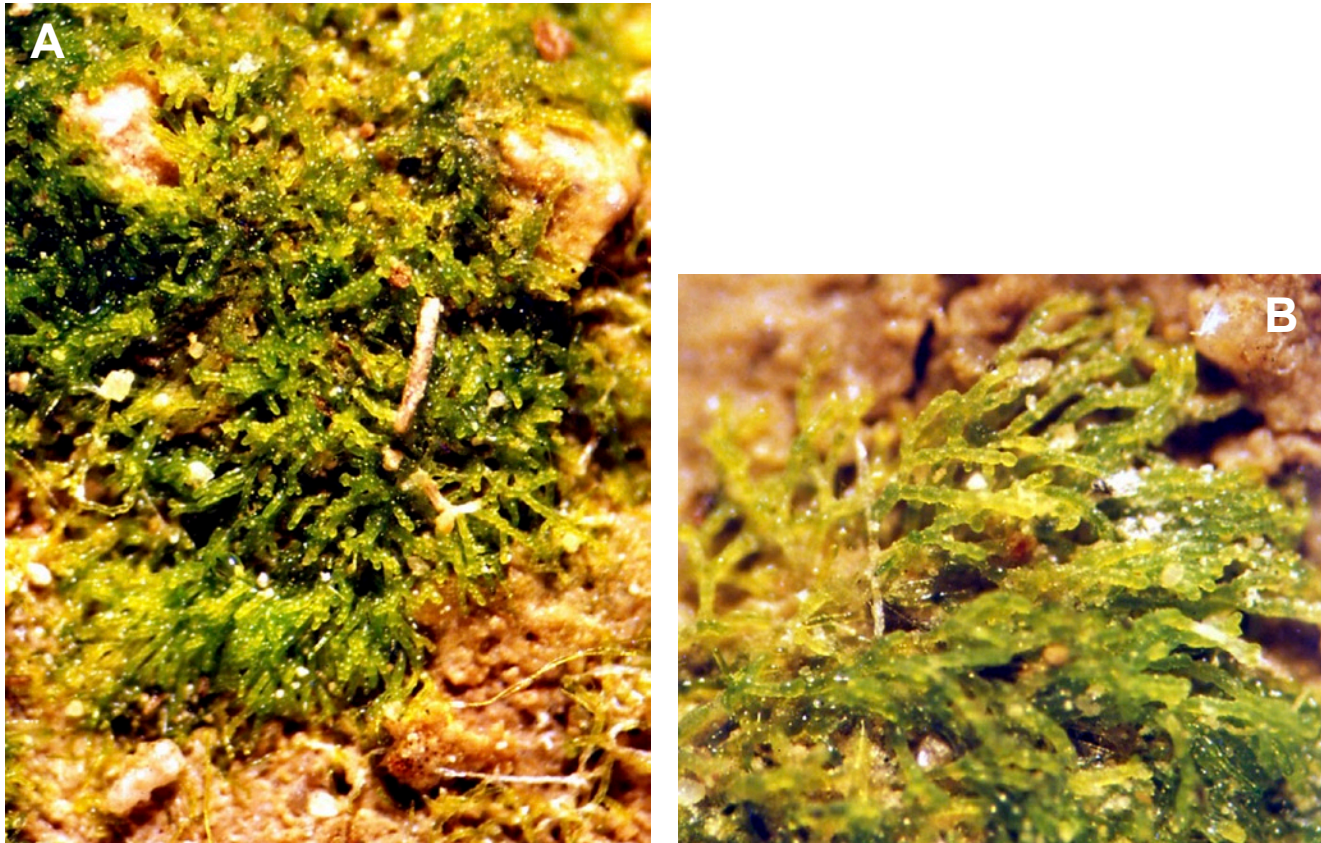


FIGURE 1. A, B. *Asterosiphon dichotomus*, detail of macroscopic morphology of thalli from living fresh material.

FIGURA 1. A, B. *Asterosiphon dichotomus*, detalle de la morfología de los talos a partir de material fresco.

an irregular dichotomous branching system (Fig. 2 A, B), which was radially arranged from the centre of the thallus to the periphery. Nearly all branches formed ellipsoidal and uniseriate akinetes at the ends, which were 45-50 μm in diameter and 84-92 μm in length (Fig. 2 C, D).

The samples collected in February 1996 were cultured for three weeks. In this period, the vegetative growth was inconspicuous. The addition of liquid media to the culture stimulated filament growth. The new filaments showed rapid longitudinal growth and a few presented irregular and scarce dichotomous branching. These long branches were tapered towards the apex. The filament ends were hyaline, with few chloroplasts and they usually grew into the agar layer. These endings may be the origin of the new rhizoidal system.

After three weeks, the filaments were still scarcely dichotomously branched and usually ended with a rhizoid. The akinete formation was not limited to the end segments, the whole vegetative filaments started to produce uniseriate akinetes. This character differs slightly from the dichotomous rosette typical of this taxon. This difference

possibly could be produced by the depletion of nutrients in the agar plates.

The distribution of this taxon is still not known. It has been recorded in Argentina (Lacoste de Díaz 1981), north Africa (Gauthier-Lièvre 1954), Asia (Hu & Wei 2006), France (De Puymaly 1924; Dangeard 1940, 1942), Germany (Rieth 1962), Greece (Christensen 1986), Switzerland, Denmark and Norway (Langangen 1994). It seems that this taxon has a cosmopolitan distribution (Ettl & Gärtner 1995), appearing mostly in wet naked soils in autumn or winter. In our opinion the scarce information of its distribution could be explained by its ephemeral life cycle.

Asterosiphon dichotomus can establish populations in Scandinavian or boreo-alpine soils, even under the snow (Langangen 1994), as well as in mediterranean semi-arid edaphic systems (Gauthier-Lièvre 1954). It seems that this taxon could live in strongly different habitats. However, it remains to be determined whether these populations belong to the same taxon, as well as check other morphological features like akinete germination, which was not observed in our cultures.

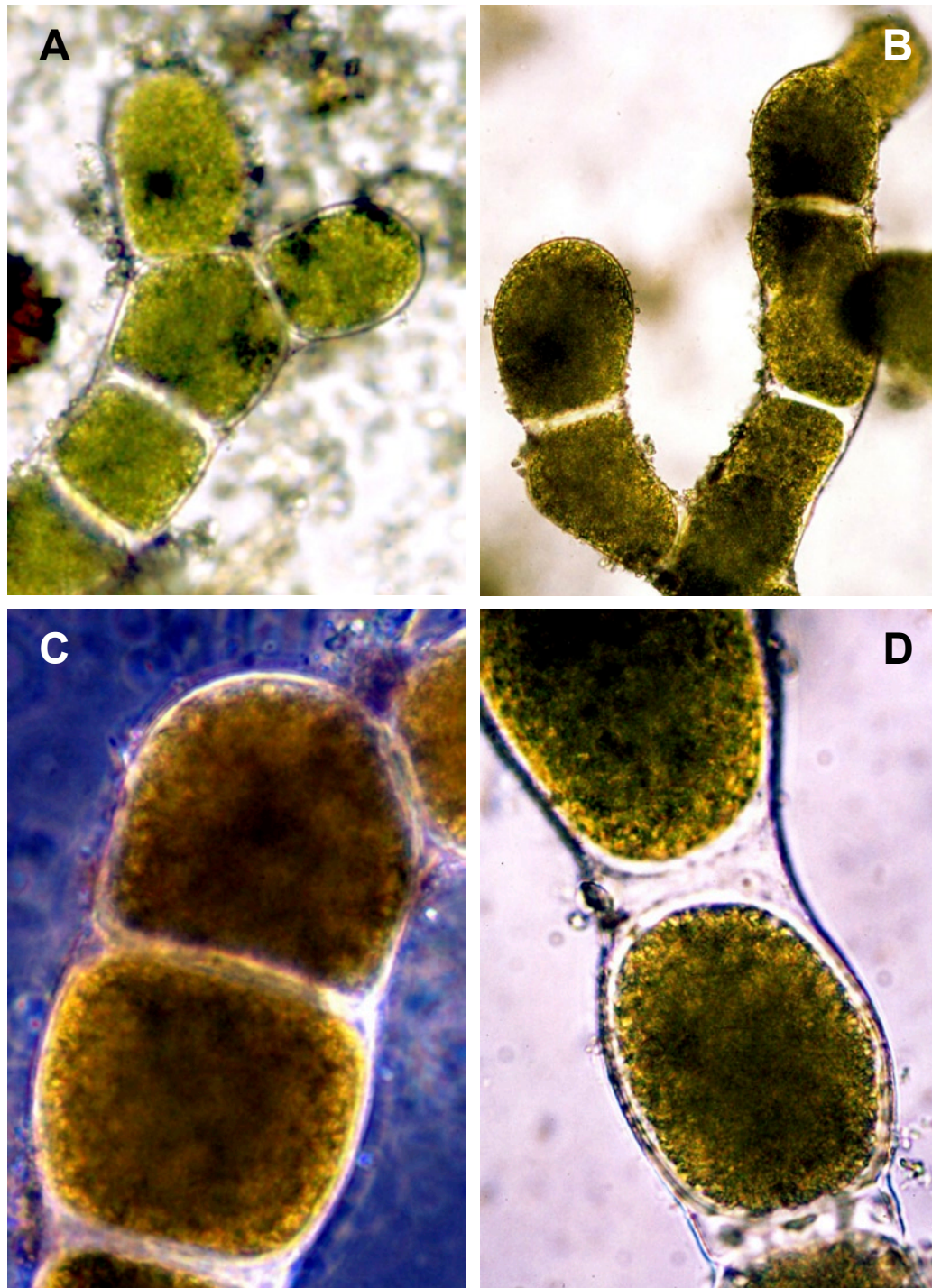


FIGURE 2. A-D. *Asterosiphon dichotomous*, branching pattern and uniseriate akinetes in the three weeks cultured and living fresh material specimens.

FIGURA 2. A-D. *Asterosiphon dichotomous*, detalle de las ramificaciones y acinetas uniseriadas a partir de material fresco y en cultivo después de tres semanas.

ACKNOWLEDGEMENTS

The author is indebted to Prof. X. Llimona (Barcelona Univ.) who collected the material. Thanks are also due to C. Balaguer, R. Gual and J. Puig, who helped in cultured the samples.

REFERENCES

- CHRISTENSEN, T. 1986. Observations on *Vaucheria* sect. *Heeringia* (Tribophyceae), including *V. incurva* sp. nov. Archiv Protistenkunde 132: 277-285.
- DANGEARD, P. 1940. Sur la pretendue reproduction des *Vaucheria* par des acinetes et des spores amiboïdes et sur la nouveau genre *Asterosiphon*. Comptes Rendus Academie Sciences 210: 719-721.
- DANGEARD, P. 1942. Le nouveau genre *Asterosiphon* et sa place systematique. Le Botaniste 31 (1): 271-293.
- ETTL, H. & G. GÄRTNER. 1995. Syllabus der Boden, Luft- und Flechtenalgen. Vol. VII. G. Fischer Verlag, Stuttgart. 721 pp.
- GAUTHIER-LIÈVRE, L. 1954. Algues Africaines nouvelles, rares ou imparfaitement connues. Bulletin Société Histoire Naturelle d'Afrique du Nord. 45: 98-111.
- GUILLARD, R.R.L. 1975. Culture of phytoplankton for feeding marine invertebrates. In: W.L. Smith & M.H. Chantey (eds), Culture of marine invertebrate animals. Plenum, New York, pp 29-60.
- HU, H. & Y. WEI. 2006. The Freshwater Algae of China. Systematics, Taxonomy and Ecology. Science Press, Pekin. 1023 pp.
- KÜTZING, F.T. 1841. Die Umwandlung niederer Algenformen in höhere, so wie auch in Gattungen ganz verschiedener Familien un Klassen höherer Cryptogamen mit zelligem Bau. Naturkundige Maatschapij Wetenschappen, Haarlem. 120 pp.
- LACOSTE DE DÍAZ, E. N. 1981. Notas algológicas. *Asterosiphon terrestre* (Xanthophyceae). Lilloa 35 (3): 85-87.
- LANGANGEN, A. 1994. Gulgrønnalgen *Asterosiphon dichotomus* funnet. Norge. Blyttia 2 : 61-66.
- PUYMALY, A. DE. 1924. Recherches sur les Algues vertes aériennes. Delbrel Ed., Bordeaux. 274 pp.
- RIETH, A. 1962. Über *Gongrosira dichotoma* Kutz. und *Asterosiphon* Dang. I. Gibt es ein "*Gongrosira*-Stadium" bei *Vaucheria*? Limnologica 1: 197-210.
- RIETH, A. 1980. *Xanthophyceae* 2. Teil 2. In: H. Ettl, J. Gerloff & H. Heynig (eds.), Süßwasserflora von Mitteleuropa, Vol. 4. pp. G. Fischer Verlag, Stuttgart. 147 pp.

Recibido: 04.12.08
Aceptado: 22.10.09