

New Record for Bangladesh: Two Species and Two Forms of *Nitella* Agardh

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Abstract

Nitella Ag. has been described (2002-2008) from different aquatic habitats. Two species and two forms are new for Bangladesh. These are: *Nitella gracilis* Agardh, *N. batrachosperma* (Thuill.) A. Braun, *N. furcata* var. *furcata* f. *roxburghii* (A. Br.) R.D.W. and *N. acuminata* A. Br. ex Wallm. var. *acuminata* f. *capitulifera* (T.F.A.) Wood.

Keywords: *Nitella*, New record, Characeae, Bangladesh

1. Introduction

Ecorticate charophyte *Nitella* Ag. is a cosmopolitan genus of family Characeae. The number of species recognized in 1951 (Wood, 1952) was 153 and approximately 180 were listed by Wood & Imahori (1959). Wood & Imahori (1965) restricted the number to 49 only as there were fewer distinct species. Intraspecific variation of *Nitella* Ag. is great and mostly earlier species assigned to variety and form level (Wood & Imahori 1965). Pal *et al.* (1962) reported 34 species of *Nitella* Ag. from India, Burma, Srilanka (Ceylon), Bangladesh (East Pakistan) and Pakistan. Zaneveld (1940) reported 12 species from Malaysia and adjacent countries. In Bangladesh, *Nitella* Ag. had been systematically described by different researchers (Agharkar & Kundu, 1937; Kundu, 1938; Kundu, 1959; Islam & Sarma, 1976; Zaman, 2001; Naz *et al.*, 2009) from lotic and lentic water habitats. In present communication all taxa have been documented with photo micrographic illustration and a comparative study between different researchers has also been included.

2. Materials and Methods

Specimens were collected from Chapai-Nawabgonj, Rajshahi and Thakurgaon district. Collected specimens were preserved in Transeau's solution (Transeau, 1916, pp.121-133) and dried as herbarium specimens for morphological observations. All specimens have been kept as herbarium in Phycology and Limnology laboratory, Rajshahi University, Rajshahi, Bangladesh and *Nitella gracilis* has been kept in Rostock University, Rostock, Germany. Liquid preservative is much more convenient for Charophyta, the specimens are less damaged and easier to identify. Photomicrographs of more important parts of a particular species, especially dactyls, sex organs, oospore etc. was taken with the help of Vivitar V3200 camera under a Reichert (Nr. 309209) microscope. During present study 8% KOH was used to the observation the ornamentation pattern of oospore wall.

3. Taxonomic Enumeration

Nitella gracilis (Sm.) Agardh, Syst. Alg., p. 125.1824. (**Fig. 1. A-H; Fig. 5. A-G**)

Synonym: *Nitella gracilis* subsp. *gracilis* var. *gracilis* f. *gracilis* (Sm.) C. Agardh, Wood 1962, Taxon 11: 20.

(Groves & Webster, 1920, 117, Pl.13, Figs. 1-7; Wood & Imahori, 1964,1965, 597, Icones 310-315, 317-320, 322, 323, 326-340; Krause, 1997, 160, Fig.65, A-I; Schubert & Blindow, 2003, 181, Figs. 4.22.1: A-D; Blindow *et al.*, 2007, 165, Fig. 37: A-H)

Plant monoecious, height up to 4 cm, color whitish green, richly fertile, thin mucus enveloped with whorl, very much slender; branchlet and internodes height up to 1 cm; stem 243-329 μm and branchlet 172 μm in diameter, 6-8 in a whorl; accessory branchlet absent; branchlet 2-3 times furcate, primaries 1/3 of the total branchlet; forked into 3-10, few are again forked into 3-6, one time again forked into 5, sometimes all secondary rays 5 in number; dactyls elongated, slightly incurved, out curved, 2-3 celled; ultimate cell conical, forms an acute apex and is about 2/3 as broad as the sub apical cell; gametangia usually sejoined, sometimes conjoined, present at all or 2nd, 3rd furcations, occasionally absent at the first furcation of a branchlet; nucules 125-248 μm long (including corona), 76-201 μm wide, convolutions 8; corona 26-34 μm long, 33-43 μm wide at base; oospore color brown, globose, 191-218 μm long, 175-182 μm wide, 5 inconspicuous ridges, membrane granulate; globules 168-182 μm in diameter.

Material studied and locality: Collection number N 2; Fotepur Beel, Salua union, Charghat, Rajshahi. January 4, 2004. Fotepur beel is situated near Sardah station at Charghat Upazila in Rajshahi district. It lies between 24° 16' 59.88" N, 88° 46' 30".

Habitat: Rice field, 5 cm depth of freshwater.

General: Branchlet divided 2-3 times, end segments 2-3 celled, end cell about as broad as penultimate cell, monoecious.

Risk of confusion: Sterile plants of *N. gracilis* can be distinguished from *N. wahlbergiana* and *N. mucronata* by a more slender appearance. In contrast to *N. wahlbergiana*, fertile heads of *N. gracilis* are not condensed. *N. mucronata* is more robust and has a reticulate oospore membrane. Small specimens can be confused with *N. confervacea* (Schubert & Blindow, 2003).

Reference to Bangladesh: Not known.

Distribution: Europe: England, Ireland, Denmark, Rumania, Norway, Sweden, Finland, France, Belgium, Germany, Switzerland, Austria, Hungary, Italy, and Russia; Asia (Note 1): India, China; Africa and New Caledonia, Poland, Latvia, Czech Republic: Eight locations in Bohmen, Balkan, Estonia, and Lithuania. It is also found in freshwater in all countries bordering the Baltic Sea.

***Nitella batrachosperma* (Thuill.) Agardh, Syst. Alg., p. 126. 1824. (Fig. 2. A-L; Fig. 6. A-D)**

Synonym: *Nitella gracilis* var. *confervacea* f. *confervacea* (Thuill. acc. Rchb.) R. D. Wood 1962.

(Groves & Webster, 1920, 124, Pl. 15, Figs. 1-9; Zaneveld, 1940, 80; Pal *et al.*, 1962, 54, Figs. 41-45; Wood & Imahori, 1964, 1965, 616, Icones 313, 327, 328; Krause, 1997, 158, Fig. 64; Langangen & Leghari, 2001; Schubert & Blindow, 2003, 168, Figs. 4.20.1, A-F)

Plant monoecious, up to 5 cm high, without mucus, flexible, bushy, soft, extremely slender; color bright green; stem 54-57 μm and branchlet 28-43 μm in diameter; lower whorl usually sterile, upper whorl fertile; branchlet 5-6 in a whorl, 1-2, rarely 3 times furcate, sterile branchlet elongate, primaries 1/2 the length of the total branchlets, secondaries 3-4, some of which are simple; sometimes incurved, tertiaries 2-4, sometimes unequal, rarely forked into 2-3 quinarities; fertile branchlet 3-4 in a whorl, primaries 1/2 of the total branchlet, secondaries 2-5, some of which are simple (no furcations), elongate, tertiaries usually 2-3, rarely again forked into 2-3 quinarities; dactyls 2-4, 2-celled, elongate, unequal, lower cell of dactyls tapering; slightly broader at the apex than the base of ultimate cell; ultimate cell narrow, ending in a point; gametangia are situated all furcations at a young whorl, sejoined gametangia are present on the 1st, 2nd furcations at a long branchlet; nucules 186-300 μm long (including corona), 172-272 μm wide, convolutions 6-8; corona 43 μm long, 56 μm wide; globules 200-257 μm in diameter; oospore not observed (unripe nucules).

Material studied and locality: Collection number. N 3, February 19, 2007. The Padma River, in front of the Padma garden, Rajshahi City Corporation, Rajshahi and located at 24°22'0" N, 88°36'0" E.

Habitat: Above 5cm depth of freshwater, River.

Risk of confusion: According to Langangen & Leghari (2001), plants small, to 5 cm high, dactyls 3-5, uniformly 2-celled, monoecious, gametangia at all fertile nodes, oospore membrane granulate. This description accurately matches the described specimen found in present study.

N. batrachosperma can be confused with *N. hyalina*, *N. wahlbergiana* and *N. gracilis*. From *N. hyalina* it can be distinguished by the uniform length of the branchlets. *N. wahlbergiana*, which also can be very small, is less slender, and most gametangia are situated on the second furcation of the branchlets (Only some on the first). *N. gracilis* is sparser and does not compact heads. Its dactyls are often 3-celled (Schubert & Blindow, 2003).

Reference to Bangladesh: Not known.

Distribution: Asia: India, Burma, Japan, Kazakhstan, Pakistan; Europe: France, South and Central Finland, Spain, South Norway, Italy, South Sweden, North Sweden, Denmark, Germany, Ireland, Scotland, Portugal, Belgium, Latvia and Poland; USA, Africa: Morocco; Australia, New Zealand, but not in South America.

Nitella furcata* var. *furcata* f. *roxburghii (A. Br.) R.D.W., Weinheim, J. Cramer. 482 1965 (**Fig. 3. A-J; Fig. 6. E-F**)

Synonym: *Nitella roxburghii* Braun 1849, Hooker's Jour. Bot. 1: 293; *Nitella furcata* var. *roxburghii* (A. Braun) Zaneveld, 1940, Blumea. 4: 92-93.

(Zaneveld, 1940, 92; Pal *et al.*, 1962, 64, Fig. 80; Wood & Imahori 1965, 482)

Plant monoecious, height up to 15 cm, slender, moderately stout, robust; branchlet 7 in a whorl, height 5 cm; stem 615 µm and branchlet 265-286 µm in diameter; sterile branchlet longer than fertile branchlet, spreading, 1-2 times furcate; primary ray 2/3 of the total branchlet; secondaries 2-6 in number, few are forked into 2-3 tertiaries; fertile branchlet short, compact, 3 times furcate; primaries 1/2-2/3 of the total branchlet, secondaries 6-7, tertiaries 3-6 in number, few are again forked into 2-5 quaternaries; dactyls 2-celled, rarely 3-celled, unequal, generally abbreviated, 2-4 in number, ultimate cell acute; gametangia conjoined to sejoined, present 2nd to 3rd furcations at a branchlet, rarely present ultimate node, absent at the base of a whorl; nucules aggregated at first node of branchlet, 415 µm long (including corona), 286 µm wide, convolutions 8; corona 50-57 µm long, 72 µm wide at base; oospore color brown, globose, 400 µm long, 358 µm wide, 5-6 prominent ridges, thick wall, membrane reticulate; globules 215-257 µm in diameter.

Material studied and locality: Collection number N 11, March 19, 2007. Rajshahi University Campus (The East side of stadium) Motihar, Rajshahi and located at 24° 22' 0.12" N, 88° 37' 40.08" E.

Habitat: Attached with soft mud, Ditch. This charophyte mixed with *Chara braunii* Gmelin.

Reference to Bangladesh: Not known.

Distribution: Southeast Asia from India and Srilanka (Ceylon) eastward to Malay Peninsula and Philippine Islands.

Nitella acuminata* A.Br. ex Wallm. var. *acuminata* f. *capitulifera (T.F.A.) R.D.W., Taxon 11: 16.1965 (**Fig. 4. A-J; Fig. 7. A-D**)

Synonym: *Nitella capitulifera* T. F. Allen 1896, Bull. Torrey Bot. Club 23: 534, pl. 286; *Nitella acuminata* var. *capitulifera* (T.F.Allen) K. Imahori, 1951: 212-213.

(Wood & Imahori, 1964, 1965, 406, Icon 188)

Monoecious, height up to 16 cm, without mucus, stem 125 µm thick; internodes as long as branchlet, sterile branchlet 6-8 in a whorl, up to 2 cm long, 1- furcate, primaries 1/3-1/2 the length of the entire branchlet; secondaries (dactyls) 2-3, rarely 4, elongated; fertile branchlets frequently in dense heads or separate branchlets, 6-8 branchlets in a whorl, 1-furcate, primaries 1/2-2/3 the length of the entire branchlet, dactyls 1-celled, 2-4, more or less conical, straight or slightly curved, acute, acuminate; heads numerous, terminal or auxiliary, compact; gametangia solitary, geminate and conjoined, nucules 429 µm long (including corona), 315 µm wide, convolutions 9-10; corona small, 30 µm long, 43-53 µm wide at base; oospore color reddish brown; 286 µm long and 229-257 µm wide, 6-7 ridges, membrane smooth; globules 172-207 µm in diameter.

Material studied and locality: Collection number N 13; Saralia village, Thakurgaon Rajshahi. October 17, 2006; Baliadangi, Thakurgaon. December 5, 2006, located at 26° 6' N and 88° 16' E.

Habitat: Canal of rice field, 2 cm depth of freshwater.

Comment: It is easily distinguished from other forms of *N. acuminata* by presence of reddish brown oospores with smooth membrane (Wood & Imahori, 1965). Similar observation was observed in present investigation.

Reference to Bangladesh: Not known.

Distribution: Asia: Japan; Taiwan.

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Notes

Note 1. At first Faridi (1956) described as *Nitella pakistanica* Faridi from Pakistan. Then Wood & Imahori (1965) referred it as infraspecies *Nitella gracilis* (Sm.) Agardh f. *pakistanica* (Faridi) Wood.

Note 2. Gametangial measurements are given in Table 1, 2, 3 & 4 and diversified characteristics (such as: size of nucule, corona, oospore and globule etc.) have been observed by comparative findings to different reports for *N. gracilis* Agardh, *N. batrachosperma* (Thuill.) A. Braun, *Nitella furcata* var. *furcata* f. *roxburghii* (A. Br.) R.D.W. and *N. acuminata* A. Br. ex Wallm. var. *acuminata* f. *capitulifera* (T.F.A.) Wood. In present study provides a full range of measurements (Table 3). Mann & Raju (2002) reported that there is some indication that ecological factors are capable of modifying gametangial size, the extent to which this is possible is not known for the different charophyte species. The moderate differences seen in Table 3 may be considered to fall in the normal genetic variation range of this charophyte.

Table 1. Comparative study of *Nitella gracilis* (Sm.) Agardh

Gametangial feature	Groves & Webster 1920	Wood & Imahori 1965	Krause 1997	Present study 2002-08
Nucule	525 µm long 350 µm wide	225-535 µm long 180-500 µm wide	450-525 µm long 300-350 µm wide	125-248 µm long 76-201 µm wide
Convolutions	8-9	5-11	8-9	8-9
Corona	25-30 µm long	15-89 µm long 24-134 µm wide	30-50 µm long 50-60 µm wide	26-34 µm long 33-43 µm wide
Oospore	250-300 µm long 225-250 µm wide	180-400 µm long 150-345 µm wide	250-300 µm wide	191-218 µm long 175-182µm wide
Globule	300 µm in diam	120-450 µm	200-300 µm	168-182 µm

Table 2. Comparative study of *Nitella batrachosperma* (Thuill.) Agardh

Gametangial feature	Groves & Webster 1920	Pal et al. 1962	Krause 1997	Present study 2002-08
Nucule	375-450 µm long 300-350 µm wide	280 µm long 245 µm wide	375-450 µm long 275-350 µm wide	186-300 µm long 172-272 µm wide
Convolutions	8-9	8-9	8-10	6-8
Corona	15-25 µm long	28 µm long 34 µm wide	25-50 µm long 40-50 µm wide	43 µm long 56 µm wide
Oospore	225-300 µm long 200-250 µm wide	215-225 µm long 160-110 µm wide	250-350 µm long 200-250 µm wide	-
Globule	175-200 µm in diam.	175 µm	120-220 µm	200-257 µm

Table 3. Comparative study of *Nitella furcata* var. *furcata* f. *roxburghii* (A. Br.) R.D.W.

Gametangial feature	Zaneveld 1940	Pal et al. 1962	Wood & Imahori 1965	Present study 2002-08
Nucule	-	-	-	415 µm long 286 µm wide
Convolutions	-	-	-	8
Corona	-	-	-	50-57 µm long 72 µm wide
Oospore	270-310 µm long	270-320 µm long	270-310 µm long	400 µm long
Globule	-	-	220-280 µm in diam.	215-257 µm

Zaneveld (1940) and Pal *et al.* (1962) only considered the measurement of oospore. But Wood & Imahori (1965) also included the measurement of globule too.

Table 4. Comparative study of *Nitella acuminata* A.Br. ex Wallm. var. *acuminata* f. *capitulifera* (T.F.A.) R.D.W.

Gametangial feature	Wood & Imahori 1965	Present study 2002-08
Nucule	375-510 μm long 315-420 μm wide	429 μm long 315 μm wide
Convolutions	8-10	9-10
Corona	35-49 μm long 55-70 μm wide	30 μm long 43-53 μm wide
Oospore	290-340 μm long 250-300 μm wide	286 μm long 229-257 μm wide
Globule	240-330 μm in diam.	172-207 μm

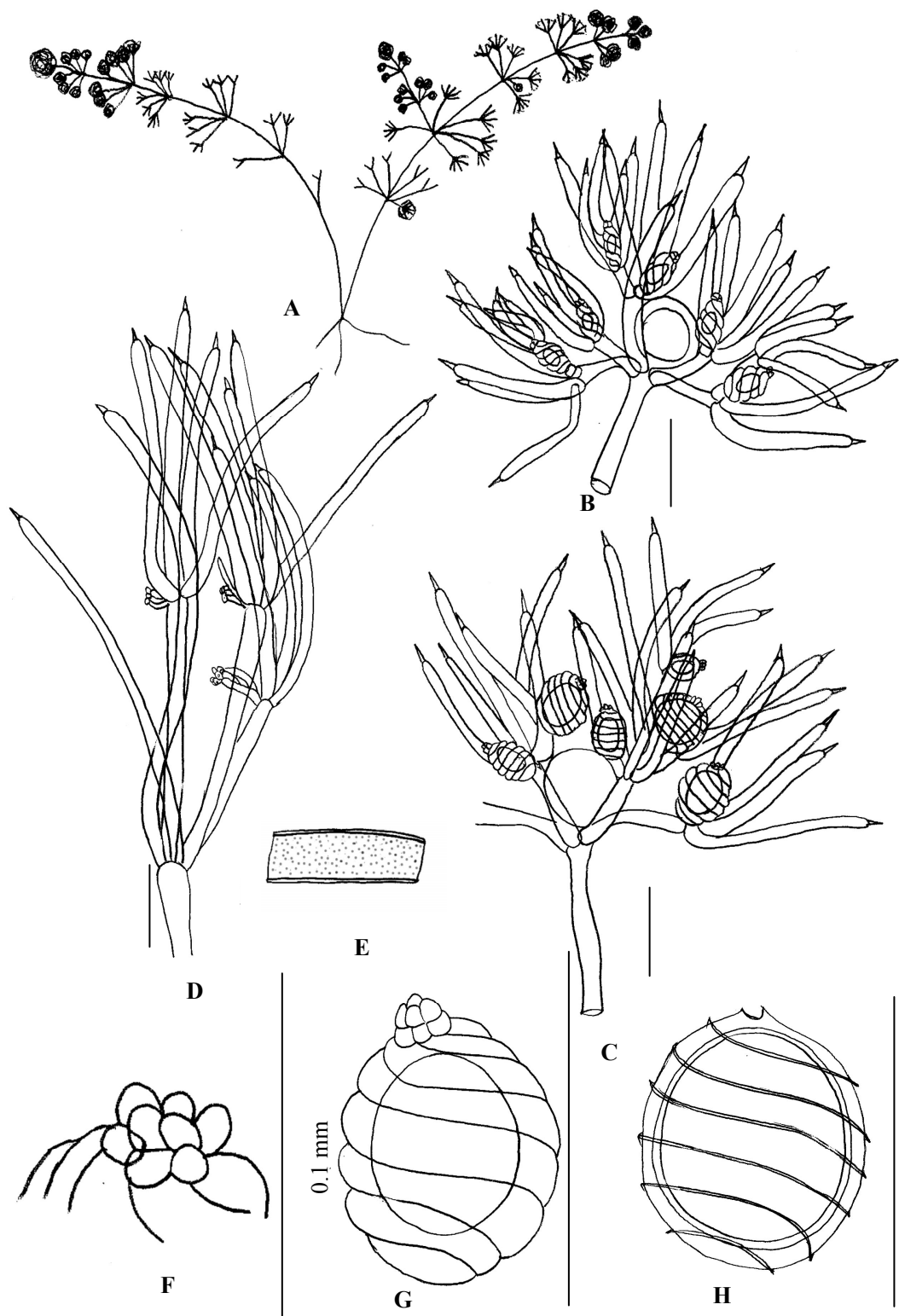


Figure 1. *Nitella gracilis* (Sm.) Agardh A. Habitus B, C. Richly fertile branchlet D. A long branchlet with unripe nucule E. Oospore membrane (free hand) F. Corona G. Nucule H. Oospore. (Scales=0.2 mm)

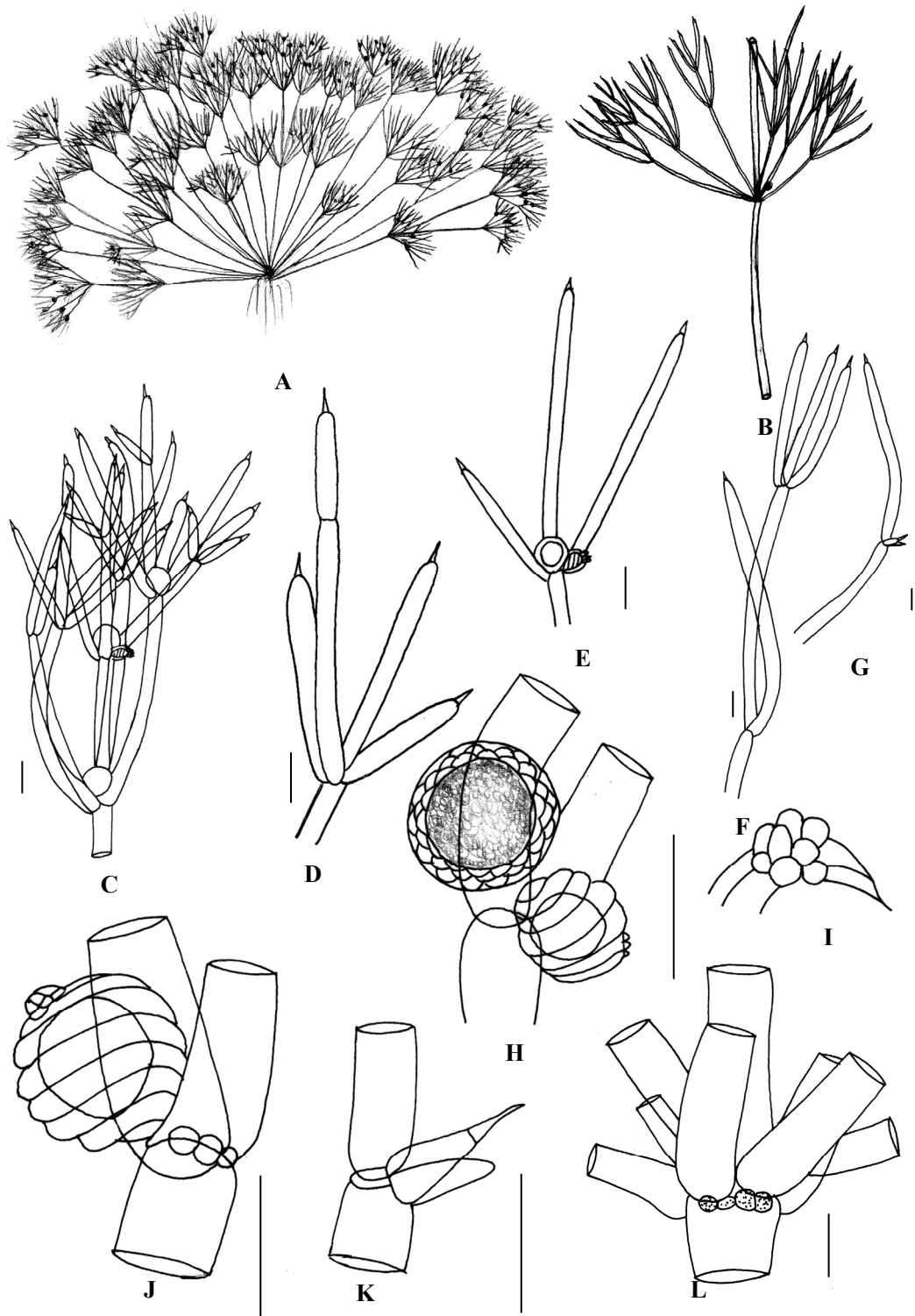


Figure 2. *Nitella batrachosperma* (Thuill.) A. Braun A. Habitus B. A whorl C. A fertile branchlet D. 3-celled dactyls E. Gametangia and 2-celled dactyls F. Upper portion of a branchlet G. Unequal dactyls H. Gametangia I. Corona J. Solitary nucule K. Tiny dactyls L. Stem node. (Scales=0.2 mm)

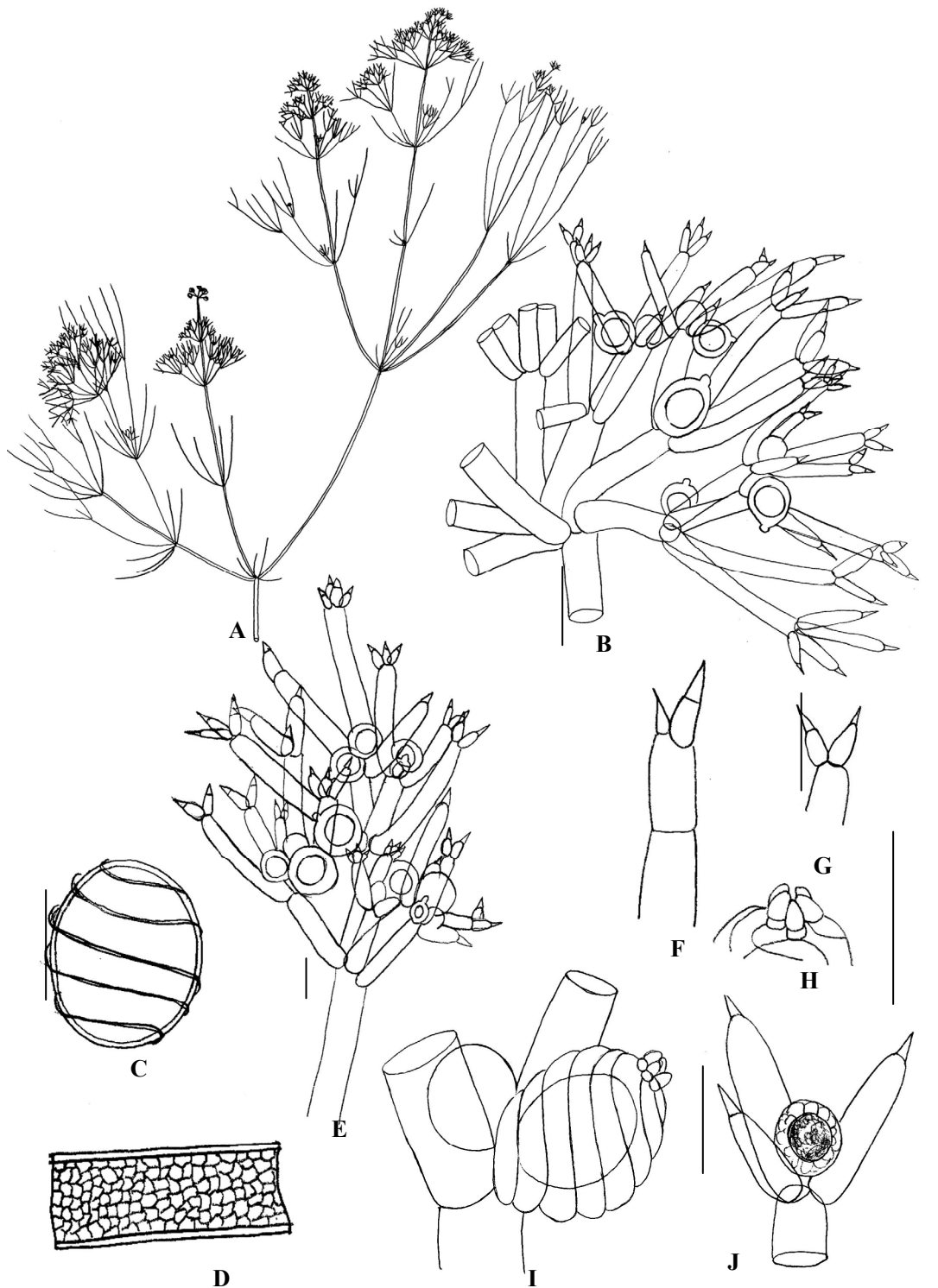


Figure 3. *Nitella furcata* var. *furcata* f. *roxburghii* (A. Br.) R.D.W. A. Habitus B. A whorl C. Oospore D. Oospore membrane E. A fertile branchlet F, G. End cells H. Corona I. Gametangia J. Globule and dactyls. (Scales=0.2 mm)

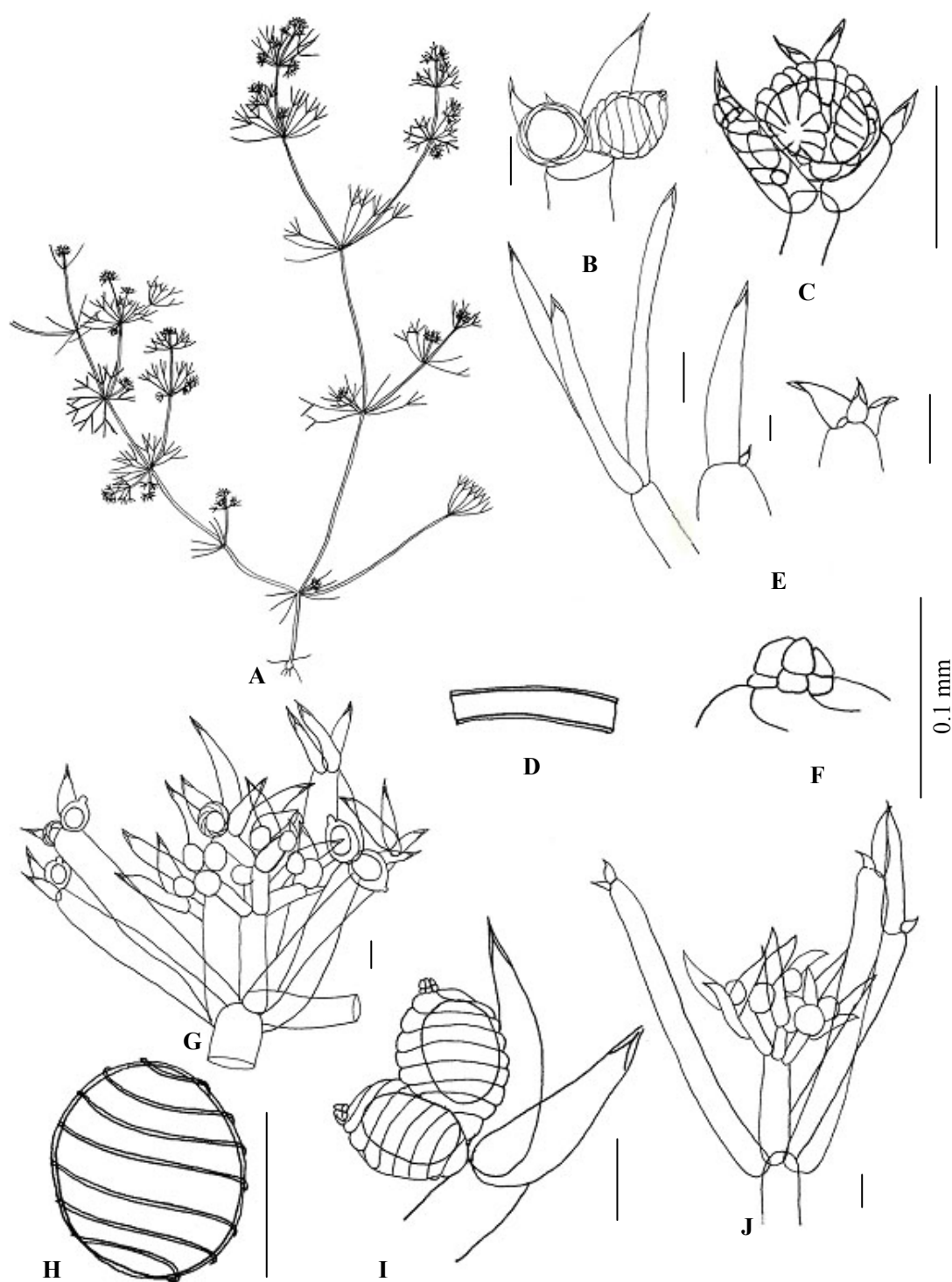


Figure 4. *Nitella acuminata* A.Br. ex Wallm. var. *acuminata* f. *capitulifera* (T.F.A.) R.D.W. A. Habitus B, I. Ultimate node with geminate nucule C. Ultimate node with gametangia D. Oospore membrane (free hand) E. Dactyls F. Corona G. A fertile whorl H. Oospore J. A young compact fertile whorl with diffuse branchlet. (Scales=0.2 mm)

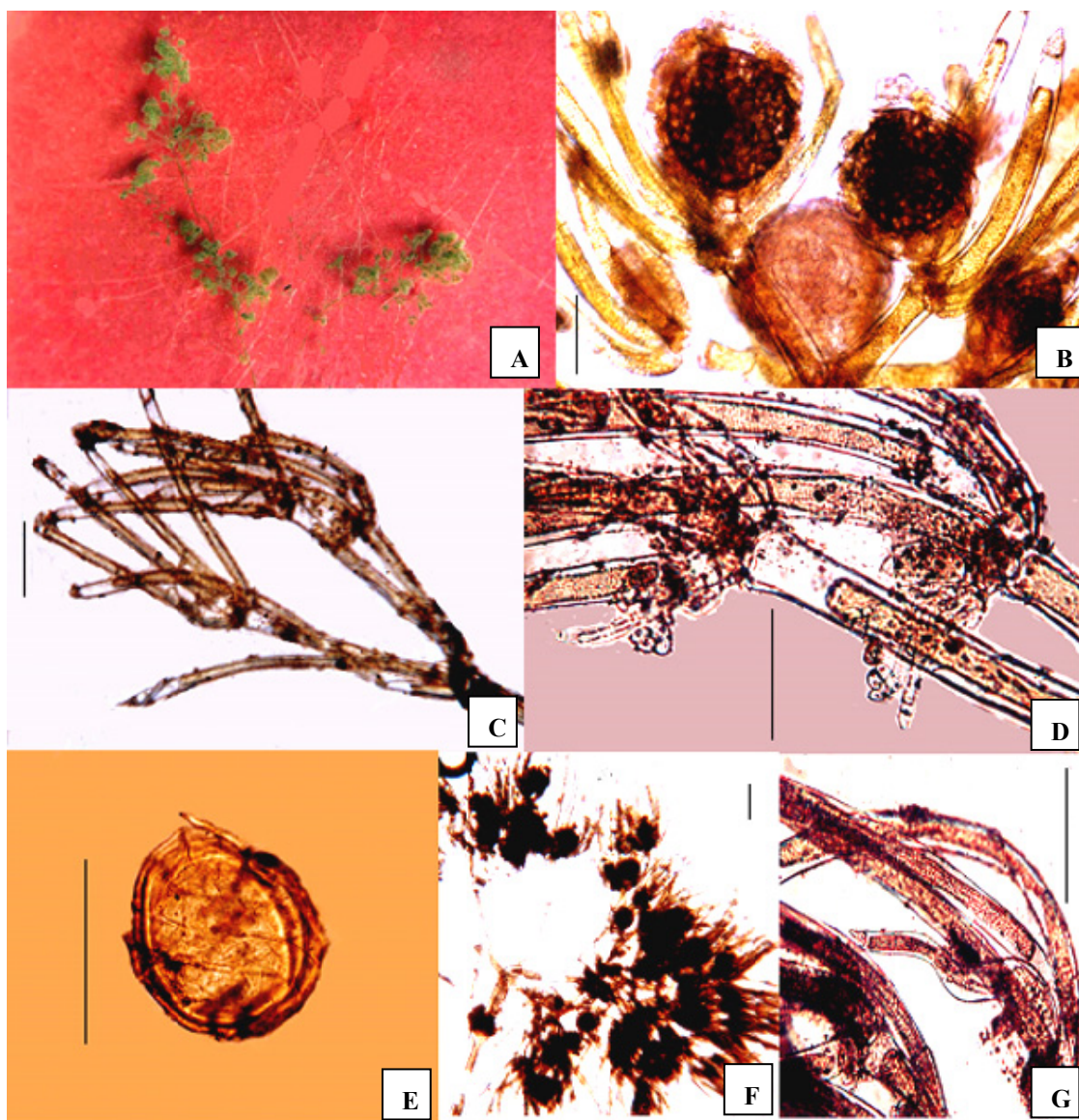


Figure 5. *Nitella gracilis* (Sm.) Agardh A. Habitus B. Gametangia C. A sterile branchlet D. Immature nucule E. Oospore F. A whorl G. Curved dactyls (Aberration). (Scales= 0.2 mm)

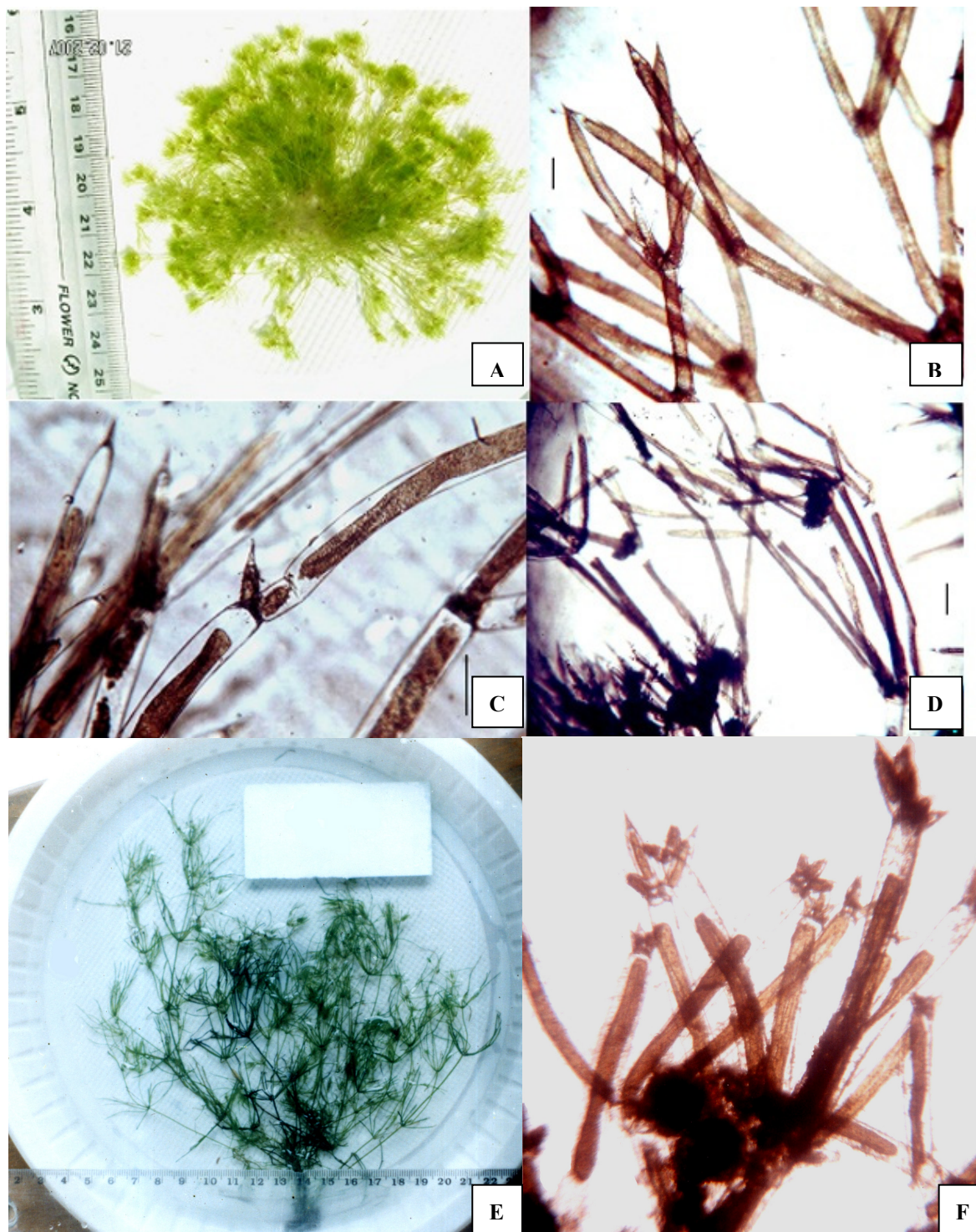


Figure 6. *Nitella batrachosperma* (Thuill.) Agardh A. Habitus B. Sterile branchlet C. Unequal dactyls D. Elongated fertile branchlet. *Nitella furcata* var. *furcata* f. *roxburghii* (A. Br.) R.D.W. E. Habitus F. Apices of branchlet . (Scales= 0.2 mm)

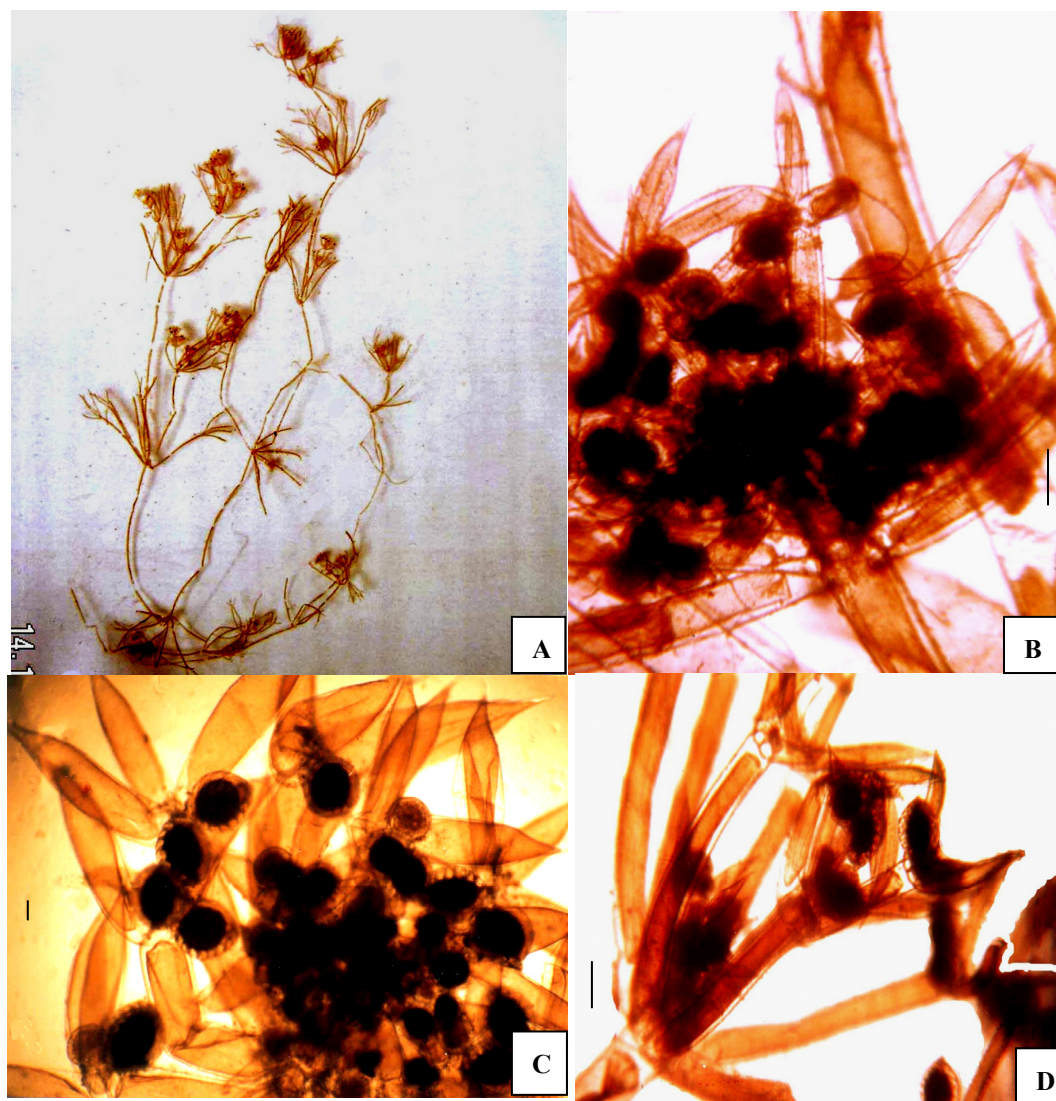


Figure 7. *Nitella acuminata* A. Br. ex Wallm. var. *acuminata* f. *capitulifera* (T.F.A.)

Wood A. Habitus B. A fertile short whorl C. Dactyls with gametangia D. A defuse whorl. (Scales= 0.2 mm)