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[Note]

Two Species of *Batrachospermum* from Orissa State, Eastern India

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Two species of *Batrachospermum*, *B. longiarticulatum* Necchi and *B. vagum* (Roth) C. Agardh are reported from fast running streams of Orissa state, in eastern India. *B. longiarticulatum*, previously known only from Brazil is a new record for India. This brings the number of *Batrachospermum* species known from India to 14.

Key Words: *Batrachospermum longiarticulatum*, *B. vagum*, India, Rhodophyta

INTRODUCTION

Freshwater red algae comprise a heterogeneous assemblage consisting of about 150 species in twenty-eight genera spread over eleven orders (Sheath 1984, 2003). Most freshwater species are lotic forms that occur in streams and rivers, although a few species are lentic forms found in lakes and ponds (Sheath and Hambrock 1990; Sheath *et al.* 1992). A small number of non marine rhodophytes occur in habitats other than typical freshwater, such as hot springs (Doemel and Brock 1971), soils (Geitler 1932), caves (Nagy 1965; Hoffmann 1989) and even on sloth hairs (Wujek and Timpano 1986).

A total of 43 species in 14 genera of freshwater red algae has been reported from India in the area ranging from the Himalayan foothills to the tropical southern region and the Andaman islands. Of these a maximum of 13 species belong to the genus *Batrachospermum*. *Batrachospermum vagum* (Roth) C. Agardh was first reported from India by Krempelhuber (1869) from South Andaman, and then again by Martens (1871). Biswas (1949) later reported this species from Crinoline falls, Shillong, Meghalaya. Subsequently twelve other species e.g. *B. bharadwajii, B. desikacharyi, B. balakrishnanii, B. iyengarii, B. mahabaleswarensis, B. umamaheswararaoi, B. kylinii, B. ectocarpum, B. moniliforme, B. nodosum, B. dasyphyllum* and *B. zeylanicum* were reported from southern, western and northern regions of India (Misra and Dey 1959; Patel and Francis 1968; Shaikh and Vaidya 1972; Balakrishnan and Chaugule 1975, 1980a, b, c; Chaturvedi *et al.* 1978; Pandey and Chaturvedi 1979; Chaugule 1980; Sankaran 1984; Baluswami and Babu 1999; John and Francis 2007) of which the first six were new species. Though Orissa state in the eastern India has numerous water bodies including six perennial rivers and several mountain streams, the area has not been extensively explored for freshwater rhodophytes. Recently we reported the occurrence of three ecophenes of *Compsopogon coeruleus* (Balbis) Montagne from this region (Ratha *et al.* 2007). Here we report two *Batrachospermum* species from Orissa of which *Batrachospermum longiarticulatum* Necchi is a first record from India.

MATERIALS AND METHODS

We surveyed algal forms in various freshwater habitats of Orissa State (17° 49′-22° 34′ N, 81° 24′-87° 29′ E) comprising of canals, ponds, lakes, streams and rivers during December 2003 to October 2007. *Batrachospermum* species were found in two locations. Samples were collected and fixed on the spot with 4% formaldehyde. Temperature, pH and conductivity of water at the collection site were also recorded. Microphotographs of the specimens were taken using a Meiji Trinocular Research microscope fitted with Nikon Coolpix 4500 digital camera. Habitat and the date of collection of each sample were noted, and specimens were assigned voucher numbers and deposited in the herbarium of the Department of Botany, Utkal University. Organisms were identified following Desikachary *et al.* (1990), Necchi (1990) and Sheath (2003).

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SYSTEMATIC ENUMERATION OF TAXA

Order: Batrachospermales
Family: Batrachospermaceae
Genus: *Batrachospermum* Roth

1. *Batrachospermum longiarticulatum* Necchi (Figs 1A-L)

Necchi, O. Jr., 1990, p. 31-37, figs 39-42.

Thalli 3-16 cm high and bluish-green, becoming blackish when dry, with abundant mucosa. Branching is irregular and abundant, with main branch distinct, 1.2-2.5 mm wide, and with straight apices (Fig. 1A). Whorls well developed, dense; internodes 0.5-1.1 mm long and pericentral cell ovoid or conic (Fig. 1B). Primary fascicles straight, distal ends curve, 20-32 cells (Figs 1C-D). Proximal cells cylindric or elliptic, length/width 30-12 × 6-18 μm; distal cells elliptic or subspheric, 8-15 μm long, 5-8 μm broad; branches dichotomous, 5-10 (Fig. 1E). Hairs numerous, short or long, base inflated. Secondary fascicles few. Thalli monoecious with spherical spermantangia, terminal or subterminal, with primary fascicles 5-7 μm diameter (Fig. 1K). Carpogonia bearing branches straight, 12-22 celled, 120-250 μm long, proximal cells cylindrical or barrel shaped, 10-20 μm long, 6-15 μm broad; distal cells barrel shaped, 5-10 μm long, 5-7 μm broad. Bracts numerous, proximals long, consisting of 10-25 elliptic or obovoid cells, 2-5 elliptic or barrel shaped cells. Carpogonia symmetric, short, 22-32 μm long, base 3.5-5.5 μm wide, apex 7-9 μm wide, with club-shaped trichogynes, sessile (Fig. 1L). Carposporophytes pendunculate, 1-2 per whorl, dense, 60-160 μm diameter (Figs 1F-H). Gonimoblast filaments 3-5 cell layers; proximal cells barrel-shaped, 8-15 μm long, 8-12 μm broad; distal cells cylindric, 8-15 μm long, 4-7 μm broad (Figs 1I-J). Carposporangia obovoid or club-shaped, 13-28 μm long, 8.5-14 μm broad.

Epilithic (attached to rock surfaces at up to 30 cm depth) in clear water of a fast flowing stream. Voucher no, collection site and date: GJ 471 & GJ 558, Badadeoparbat, between Chheligarh and R. Udayagiri, Gajapati, water temperature 23-24°C, pH 6.14-6.25, conductivity 82-85 μs; 7 Oct. 2005 and 2 Jan. 2007.

Distribution: Brazil (Necchi, 1990); Habitat: moderate to fast flowing streams.

2. *Batrachospermum vagum* (Roth) C. Agardh (Figs 2A-J and 3A-E)

Desikachary *et al.* 1990; p. 94; pl. 16; Figs A-C.

Thalli 2-6 cm high and olive-green to bluish-green, becoming blackish when dry. Soft, mucilaginous, attached by rhizoids (Fig. 2A). Branching is profuse, dichotomous (Fig. 2B) and gradually tapered and with a blunt apex (Figs 2D, E). Internodes 133-138 μm long, 103-288 μm broad (Fig. 2C). The glomeruli are conspicuous, club shaped and distinct only in the younger portion (Figs 2B, E); 66-116 μm long, 75-108 μm broad. Primary fascicles 22-36, straight or slightly bent, present in a whorl. Proximal cells rectangular or ellipsoidal, 2-9 μm long, 2.8-5.4 μm broad; distal cells oval or conical, 6-10 μm in diameter (Fig. 2F). Uniaxial central cells 15-23 × 27-35 μm in diameter; pericentral cells 6-8, ovoid, elongated, 4.8-7.7 μm in diameter (Fig. 2F). Thalli monoecious with terminal spermatangia, globular or subglobular with hairs (Fig. 2G) and solitary or in clusters of 2-4, 6.3-9.4 μm in diameter (Fig. 2H). Carposporophytes penduculate, occur in nodal region, lateral, 1-2 per whorl, dense, 140-250 μm diameter (Figs 2I-J and 3A). Gonimoblast filaments 2-8 celled, distal cells elliptical, 8-17 × 6-19 μm, when cylindrical 12-19 × 26-34 μm (Fig. 3B). Bracts two to numerous, elliptic, 22-34 μm long, 6-8 μm broad. Carpogonia symmetric, ovoid or spherical, sessile. Trichogynes club shaped or ovoid and sessile (Fig. 3D). Caprosporangia terminal, orange-red coloured, single or paired, sessile, ovoid or club shaped, 16-33 μm long, 14-24 μm broad (Figs 3C, E).

Epilithic in a cold mountain spring. Voucher no, collection site and date: KD 233 & KD 233B; near Daringibadi, Kandhamal, water temperature 16-20°C, pH 5.6-6.2, conductivity 82-96 μs; 11 April 2004 and 17 Oct. 2007.

Distribution: Japan and Malaysia (Kumano 1970), North America (Sheath *et al.* 1993), India (Krempelhuber 1869, Martens 1871, Biswas 1949, Patel and Francis 1968; Shaikh and Vaidya 1972); Habitat: stream and waterfall.

DISCUSSION

Batrachospermum is a cosmopolitan genus occurring in moderately flowing unpolluted streams (Sheath 1984). Totally 47 species of *Batrachospermum* have been reported globally of which 13 species are occurring in India. We have extensively surveyed the water bodies of Orissa state covering almost 155,707 Km^2 area during 2003 to 2007 and recorded two species of *Batrachospermum*, *B. longiarticulatum* and *B. vagum* of which the former species is the first report from India. *B. longiarticulatum* was earlier recorded only once before from Brazil (Necchi 1990).

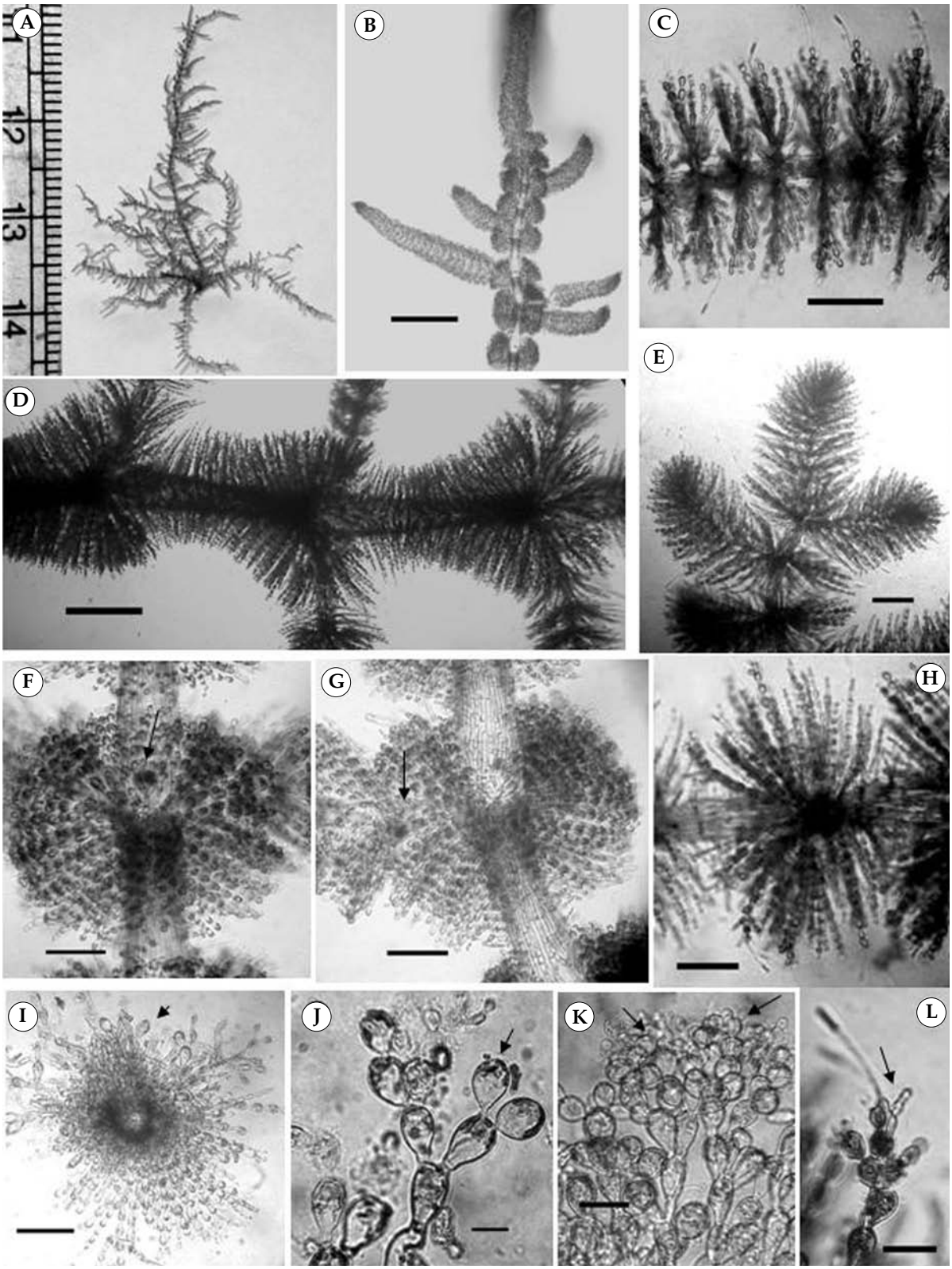

Fig. 1. *Batrachospermum longiarticulatum.* (A) Thallus with branches. (B) Main branch with attenuated lateral branches. (C) Lateral branch showing uniseriate lateral branches from the main axis. (D) Old branch showing unilateral branches from the main axis. (E) Apical portion of axis. (F) Glomeruli with carposporophyte (arrow). (G) Glomeruli with lateral carposporophyte (arrow). (H) Magnified view of corticated cells and spine like cells of the main axis. (I) T.S. of main branch. (J) Carposporangia in clusters of two to four. (K) Cluster of terminal spermatangia (L) Immature carpogonia (arrow) and hair like projection of the cell (Scale bar: A = 38.7mm; B-E, G-I = 100 μm; F = 50 μm; J, L = 30 μm; K = 10 μm).

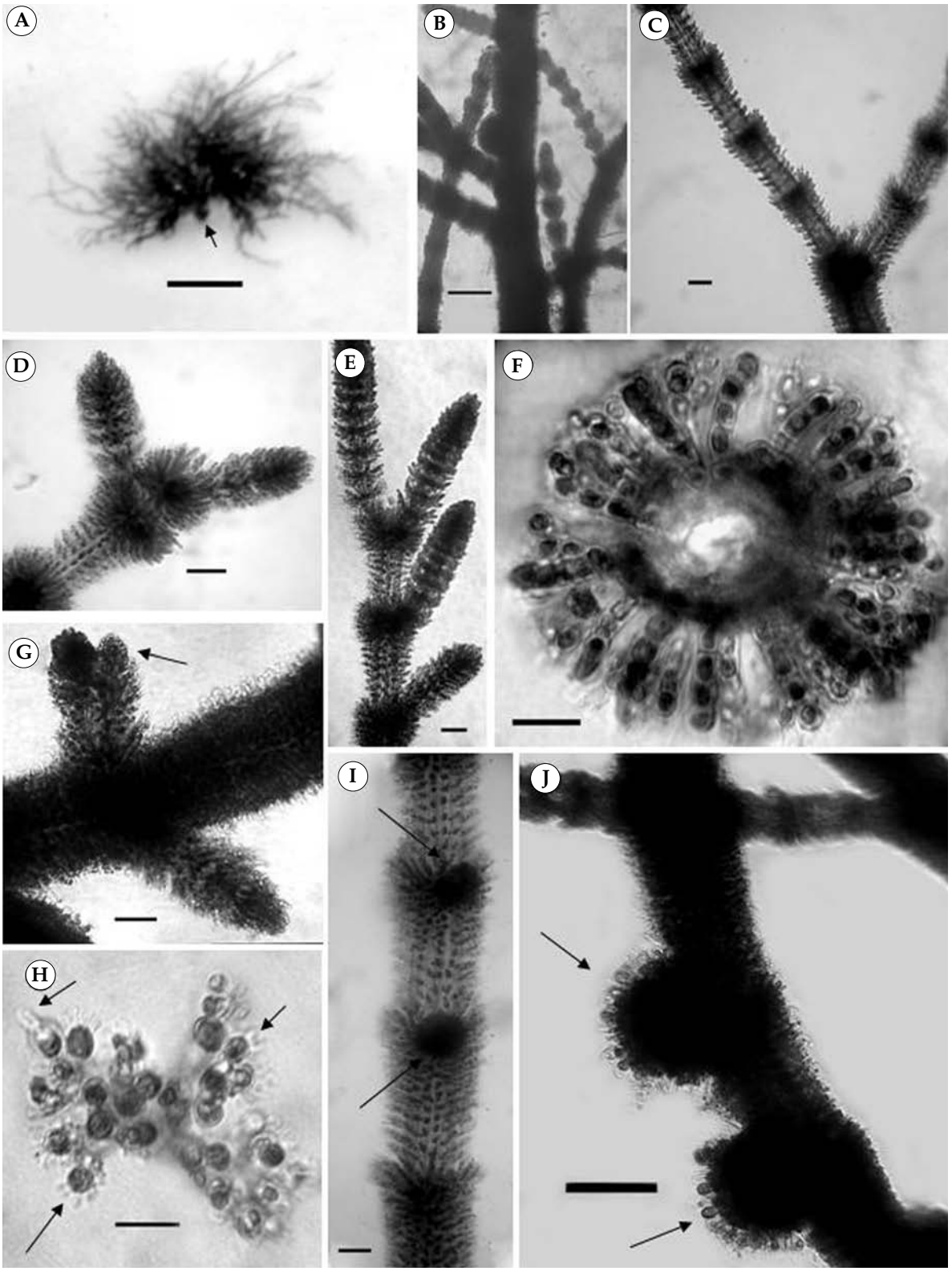

Fig. 2. *Batrachospermum vagum*. (A) Profusely branched thallus with basal region (arrow). (B) Main axis with unilateral branches. (C) Axis dichotomously branched showing node and internode. (D) Apical portion of a branch. (E) Branch with gradually tapered apices. (F) T. S. of main axis. (G) Spermatangial cluster (arrow) at the tip of lateral branch. (H) Monosporangia (arrow) with hairs at the tip of vegetative branches. (I) Main branch showing carposporophytes at the nodal region (arrow). (J) Main axis with two carposporophytes (arrow) on the same side (Scale bar: A = 1 cm; B = 200 μm; C-E, G = 50 μm; F, H = 20 μm; I = 30 μm; J = 100 μm).

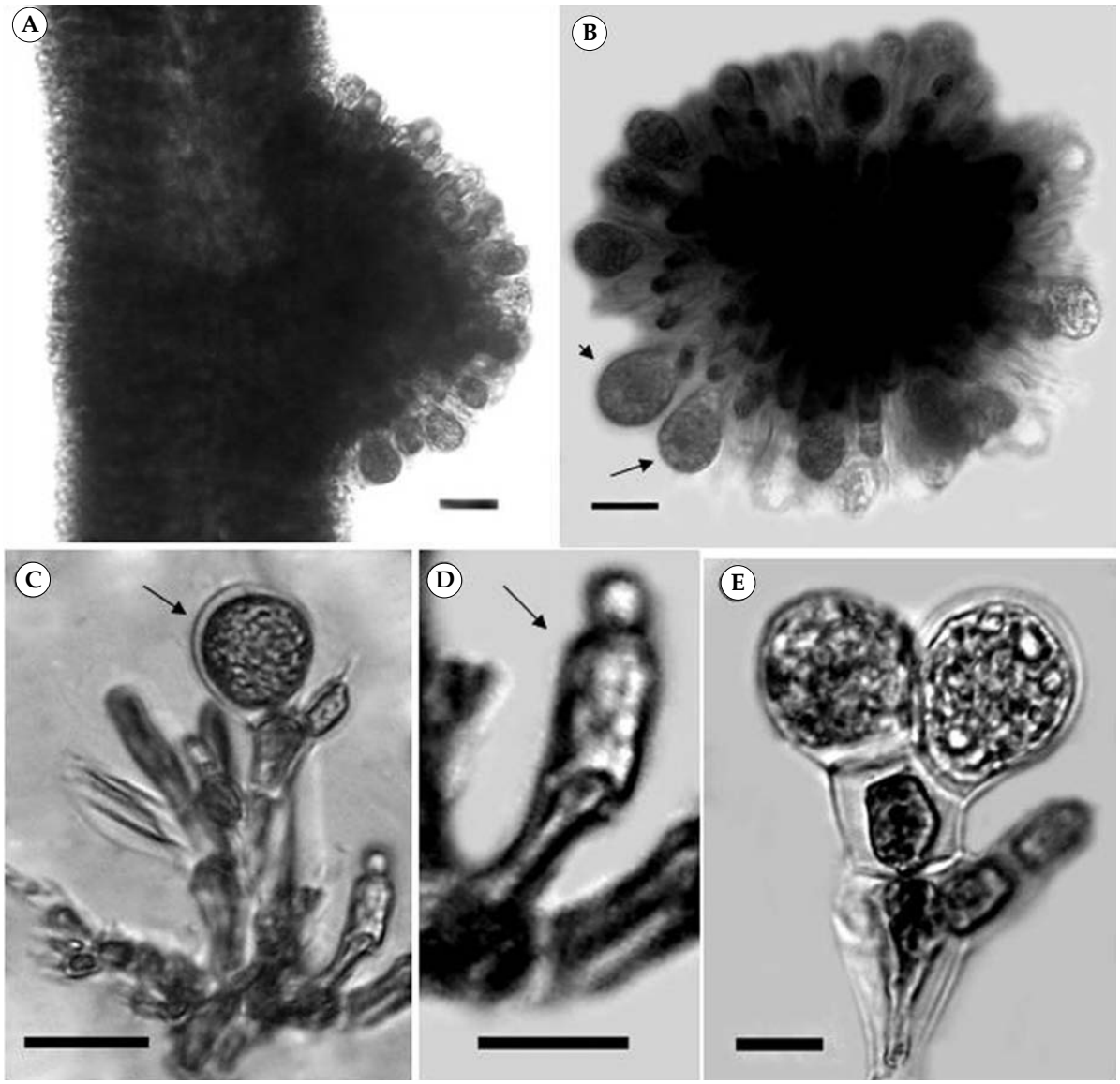

Fig. 3. *Batrachospermum vagum*. (A) Dense, spherical carposporophyte adjacent to a node. (B) Carposporophyte with large and ovoid carposporangia (arrow). (C) gonimoblast filament with carposporangium. (D) Cylindrical trichogyne (arrow) with attached spermatium(double arrow). (E) Gonimoblast filaments with apical double carposporangia (Scale bar: A = 30 μm; B, C = 20 μm; D, E = 10 μm).

This species described for the second time from India is similar to the Bazilian specimen with regard to its beaded appearance, bluish-green colour, diameter of whorls, straight primary fascicle with hairs, 3-5 celled gonimoblast filament, terminal spherical spermatangia, 22-32 μm long carpogonia and club-shaped sessile trichogynes. However, it differs with lesser diameter of carposporophytes and lager carposporangia (Necchi 1990). *B. vagum* has been reported from many places of India and also from Japan, Malaysia (Kumano *et al.* 1970) and North America (Sheath *et al.* 1993). The species recorded in the present work is having 2-8 celled gonimoblast filament and smaller in size varying from 2-6 cm high where as the earlier recorded ones were up to 20 cm high. Analysis of these results showed that the distribution of *Batrachospermum* species is not uniform globally. *B. vagum*, one of the commonly occurring species from India, South-east Aasia and North America did not occur in Brazil from where most of the *Batrachospermum* species were recorded.

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