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Inderdeep Kaur and M. R. Vijayaraghavan: Histogenesis and conceptacle organization in *Sargassum vulgare* C. Agardh (Fucales, Phaeophyta).

Key Index Words: conceptacle organization—Fucales—Phaeophyta—Sargassum vulgare—Sulphated polysaccharides.

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Sargassum vulgare C. Agardh has a three sided apical cell lodged in the apical groove. The derivatives cut by this cell lead to the formation of meristoderm, cortex and medulla. During the reproductive period, unisexual conceptacles are borne in the receptacles. The growth of the receptacle takes place by means of pyramidal truncate initial that lies at the base of a groove. The conceptacles develop near the receptacle initial from the meristoderm layer of the receptacle and later are embedded in the cortex of the receptacle.

The conceptacle development in Fucales is known (Moss 1965, 1967, 1970; McCully 1966, 1968; Critchley et al. 1991) but a correlative study on histogenesis and histochemistry is lacking. The present communication in *Sargassum vulgare* deals with histogenesis and histochemistry of the apical cell, the receptacle and the conceptacle initials and the hairs in cryptostomata.

The plants of *Sargassum vulgare* were collected during the low tide periods from Port Okha, Gujarat, through the months of January, February and November 1987-89. The desired plant parts were fixed in 10% v/v acrolein at 4°C for 24 h, washed thrice in distilled water and postfixed in 1% $HgCl_2$ for 12 h to stabilize phenolic compounds. The material was again washed twice with distilled water to remove the traces of fixatives; dehydrated through methoxy-ethanol (3 changes, 24 h); ethanol (1 change, 24 h), propanol (1 change, 24 h) and n-butanol (1 change, 24 h). The material was infiltrated and embedded in glycol methacrylate (Feder and O'Brien 1968) and sectioned on a Spencer rotary microtome fitted with a locally made adaptor to hold glass knives. Two micron thick sections were cut and serially transferred to small drops of distilled water kept on precleaned and dried slides and later stained with PAS reagent (Feder and O'Brien 1968) and TBO (McCully 1966).

For scanning electron microscopy, the selected plant parts were fixed in 4% formaldehyde, dehydrated in a graded acetone series, critical point dried and scanned for topographical detailes.

Apical cell—Organization of the vegetative apex: The plants grow by means of a three sided apical cell lodged in a groove. This cell in transverse section, appears triangular (Fig. 1) and in longitudinal section more or less biconvex (Fig. 2). The promeristem of this taxon is identical in structure and behaviour as reported for other taxa of this order. The mucilage that fills the apical groove stains reddish-violet with TBO and magenta with PAS reagent. This indicates a mixture of sulphated and carboxylated polysaccharides (Fig. 2). The apical cell walls are thin and stain identical to the mucilage.

The apical cell cuts off derivatives parallel to all its sides; these have wavy cell walls and undergo divisions and enclose a few intercellular spaces (Fig. 3). The apical cell cytoplasm reveals small vacuoles and few sulphated polysaccharides; large, polarized nucleus with prominent nucleoli (Fig. 3). The meristoderm cells near the cavity are gorged with physodes (Fig. 3).

Receptacle and conceptacle development: During the reproductive phase, the plants bear abundant receptacles. The growth of the receptacle also takes place by means of a pyramidal initial that lies at the base of the groove (Fig. 4). One of the cells in the meristoderm layer of the receptacle becomes large and functions as the conceptacle initial (Fig. 5). The cell wall of conceptacle initial contains a mixture of carboxylated and sulphated polysaccharides but the cytoplasm reveals negligible polysaccharides. The initial undergoes an unequal transverse division (Fig. 6). The upper small cell elongates and points towards the exterior and later becomes the tongue-cell which has a distinct cap that is rich in sulphated polysaccharides. The tongue-cell eventually degenerates and the lysate contributes to the ostiolar plug material (Fig. 8). The lower large cell is the mother cell of the conceptacle wall (Fig. 7) and undergoes divisions.

The young conceptacle is oval to pear-shaped and has a narrow neck (Fig. 9). As the plants reach sexual maturity, oogonia (Fig. 9) and antheridia as well as the associated paraphyses differentiate from the conceptacle wall and mature inside the cavity. The ostiole further narrows but concomitantly the base widens. The receptacles become spherical and accommodate both developing and developed sex organs.

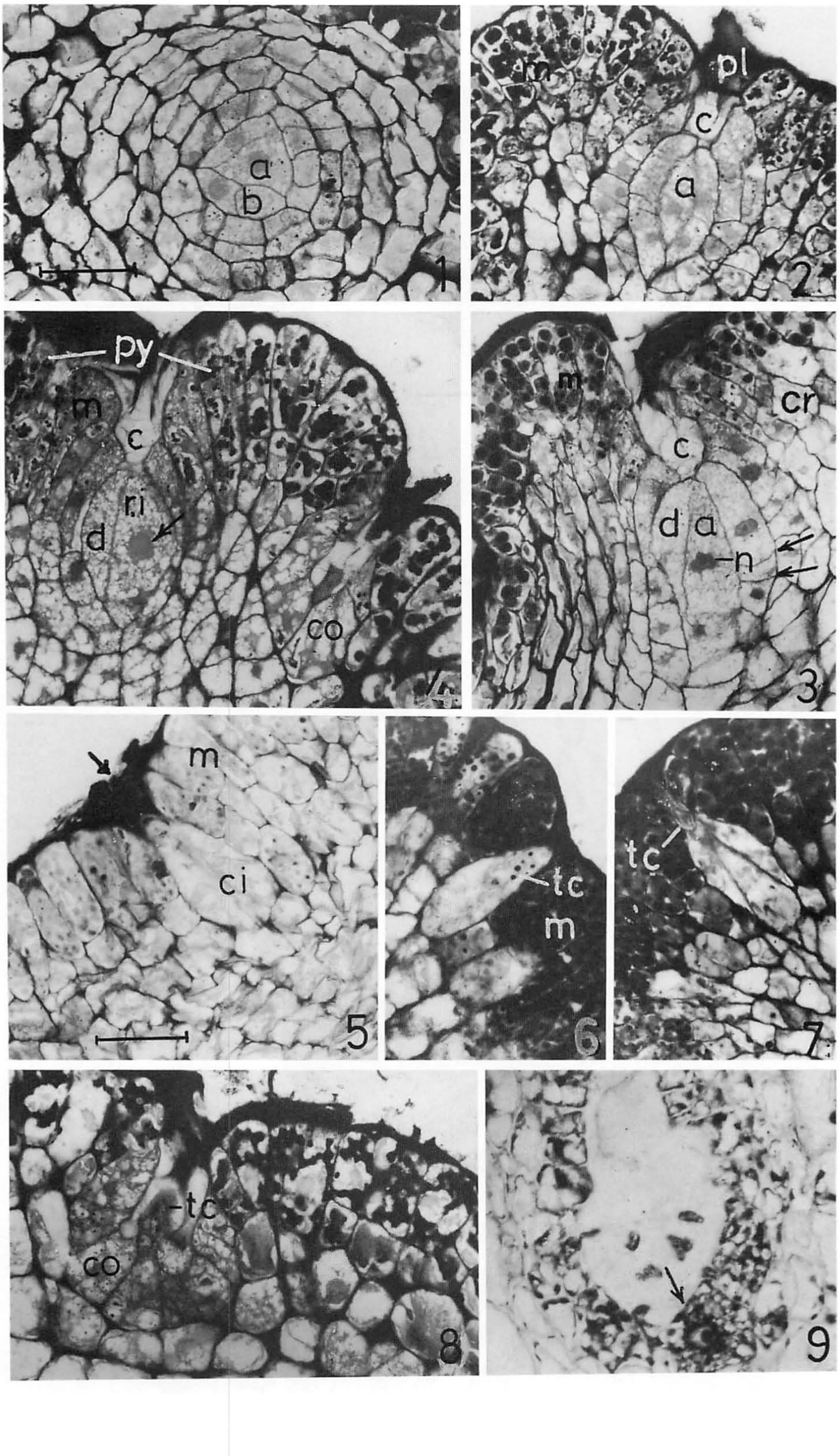
The mature conceptacle wall cell's cytoplasm reveals abundant vacuoles and physodes. At the time of gamete release, the wall cells are vacuolate. The paraphyses rich in physodes are intermingled with reproductive organs.

Cryptostomata: Besides the fertile conceptacles, sterile conceptacles (cryptostomata) occur both on the vegetative (Fig. 13) and the reproductive (Fig. 10) thalli. Cryptostomata appear as dots, and are freely scattered on the vegetative regions. In the reproductive regions, they coexist with the conceptacles. The cryptostomata show identical developmental pattern as the fertile conceptacles. The cryptostomata have abundant hairs which show only trichothallic growth (Figs. 12, 14). During the initial stages, the hairs reveal moderate polysaccharides and few physodes (Fig. 11). The nuclei are large. A mature hair has three regions. The lowermost region has meristematically active basal cell; the middle region has four to six recently formed short cells which have not yet elongated and the upper region has hairs which are partly within and partly outside the cavity (Fig. 14). The portions of hairs that emerge out, are replete with physodes, numerous vacuoles and moderate polysaccharides (Fig.15).

In *Sargassum vulgare*, the apical cell and the conceptacle initials are deep seated occupying the base of the cavity that is filled with a mixture of sulphated and carboxylated polysaccharides which protect the thalli against desiccation when the plants are exposed

Figs. 1–9. *Sargassum vulgare*, (Figs. 1–9 TBO stained, Scale bars=9.4 μm). Fig. 1. Transverse section of a vegetative thallus apex showing a triangular apical cell (a) with three cutting faces. The derivatives (d) result in formation of a promeristem. Figs. 2, 3. Longitudinal sections through the apical regions showing biconvex apical cells (a) lodged in cavity (c) filled with polysaccharide plug materials (pl). The apical cell cytoplasm bears abundant vacuoles, a few polysaccharides and a prominent nucleus (n). The derivatives (d) undergo divisions to form meristoderm (m), cortex (cr) and medulla (not seen in figure). Fig. 4. Longitudinal section through apical region of the receptacle showing a cavity (c) at the base of which is the receptacle initial (ri) with distinct nucleus (arrow). The derivatives (d) possess wavy walls. The meristoderm cells (m) are rich in physodes (py). A developing conceptacle (co) is also seen. Fig. 5. Conceptacle initial (ci) differentiates from amongst the meristoderm (m) cells. The initial is lodged in a cavity filled with polysaccharides (arrow). Fig. 6. The initial undergoes unequal transverse division resulting in tongue-cell (tc) and a basal cell. Figs. 7, 8. The basal cell divides resulting in conceptacle (co) wall formation. In 8, a polysaccharide cap covers the tongue-cell (tc). Fig. 9. The oogonial (arrow)/antheridial initials differentiate from the conceptacle wall cells.

Figs. 10–15. *Sargassum vulgare*. Figs. 10–11, 14, 15. TBO stained. Fig. 10. Longitudinal section of a receptacle passing through a cryptostoma (cy) showing a profuse growth of hairs. Scale bar=25 μm. Fig. 11. Cryptostoma cut in a longitudinal section. The young hairs (h) reveal cells that are small, rectangular with prominent nuclei (n) occupying the major portion of the cytoplasm. Scale bar=9.4 μm. Fig. 12. In the hairs (h) a few lower cells remain small whereas those towards the ostiole elongate. The cell walls (w) stain intense megenta with PAS reagent. Scale bar=9.4 μm. Fig. 13. Scanning electron micrograph of the leaf to show top view of cryptostoma with emergent hairs (h). The inset shows freely distributed cryptostomata (arrows) on a leaf portion. Scale bar=6.8 μm. Figs. 14, 15. Mature cryptostomata showing hairs (h) that have elongated. These reveal cytoplasm with a few vacuoles (v) and nucleus (n). The portion of hairs that emerges out is highly vacuolate (v). Scale bar=9.4 μm.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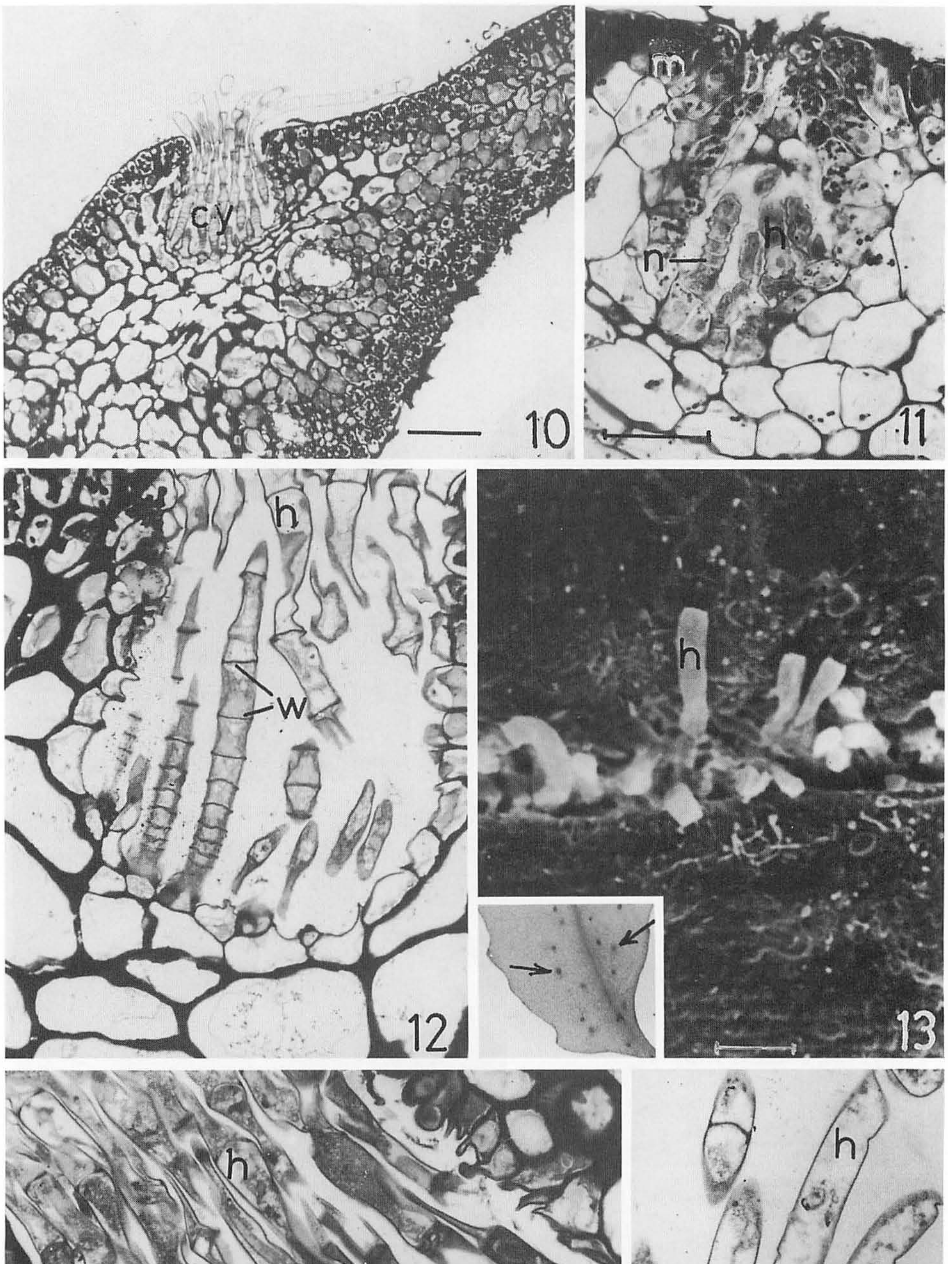
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(Vijayaraghavan and Kaur, 1991).

Tahara (1940) in *Sargassum horneri* (Turner) C. Agardh and Fensholt (1955) in *Cystophyllum* sp. referred to the formation of a "conceptacle-stopper" through the action of a tongue-cell. Critchley et al. (1991). in *S. heterophyllum* observed sulphated polysaccharides in the ostiole plug, and these are identical to the paraphysial secretions. In *S. vulgare* (present work) the ostiole plug of the female conceptacle accrues materials from: 1) tongue-cell lysis, 2) paraphyses secretions, 3) conceptacle wall cell secretions (see also Vijayaraghavan and Kaur 1991). In contrast the male conceptacle lacks ostiole plug and the conceptacle closure occurs by adpressing meristoderm cells (Vijayaraghavan and Kaur 1992).

Further, in *Sargassum vulgare* the ostiole closure is a presaged and coordinated phenomenon persisting until the oogonia/antheridia mature and lyse to pave way for the eventual release of respective reproductive bodies.

The distribution pattern morphology of the cryptostomata and the conceptacles on the thallus surface is noteworthy. The conceptacles are more closely placed than the cryptostomata. The young conceptacles occupy very little space in the apex of a receptacle but further down the developing, flask-shaped, conceptacles require more space. The cryptostomata are scattered on both the vegetative and reproductive structures and are bereft of plug materials. The hairs in cryptostomata show trichothallic growth. This type of basal meristem is found in many phaeophycean taxa belonging to Ectocarpales, Desmarestiales, Tilopteridales, Cutlariales, and Laminariales. (Fritsch 1945). Thus, the hairs in Fucales, as in other phaeophycean taxa represent an evolutionary primitive mode of growth. The thallus shows more advanced apical growth.

The occurrence of conceptacles in receptacles and the appearance of cryptostomata on both vegetative and reproductive branches and differential amount of plug materials suggest a line of evolution from plants which discriminately bear scattered conceptacles over the leaf and branch surfaces to those taxa with conceptacles localised on special branches. Certain branches were set apart to bear conceptacles as these conceptacles in other parts of the plant body were rendered sterile and thus changed into cryptostomata (Simons 1906). The present work supports these observations.

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Inderdeep Kaur・M. R. Vijayaraghavan：*Sargassum vulgare* C. Agardh
（褐藻；ヒバマタ目）の組織発生と生殖器巣形成

Sargassum vulgare C. Agardh は三稜形の頂端細胞を頂端部のくぼみに有する。この頂端細胞から切り出された細胞が形成表皮、皮層および髄層を形成する。成熟期には生殖器床に単性の生殖器巣が生じる。生殖器床の発達は頂端のくぼみの基部に位置する先端を切った三角錐形のイニシャルによって起こる。生殖器巣は生殖器床のイニシャルの近くに生殖器床の形成表皮から発達し、後に生殖器床の皮層の中に埋まるようになる。(Department of Botany, University of Delhi, Delhi 110007, India)

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