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Conceptacular development in *Sargassum filicinum* and autumnal *S. horneri* (Phaeophyceae)

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Conceptacular development was studied in *Sargassum filicinum* and autumnal *S. horneri*, and was compared with that of *S. horneri*. The initial cell is divided unequally to produce the tongue cell and the lower cell. Further longitudinal divisions of the lower cell follow, thus forming a lining for the depression. The tongue cell, with no divisions in it, leaves the floor when there are eleven cells surrounding and is transferred to the ostiole, where it forms a loose plug. The time of the tongue-cell's dislodgement and its conditions at the ostiole are almost the same as those reported for *S. enerve* (=*S. fulvellum*), though not for *S. horneri*.

Key Index Words: *autumnal* Sargassum horneri—*conceptacular development*—*Fucales*—*Phaeophyceae*—Sargassum filicinum—*tongue cell.*

In his three reports, Tahara (1940, 1941a, b) described some different modes of conceptacular development in the sixteen fucaleans found in Japanese waters. As *Sargassum filicinum* had been considered to be a rare species until 1950s, this alga was not dealt with by Tahara. Though Sawada (1955, 1956) reported some characteristics of *S. filicinum* from much more material, conceptacular development was not included in his papers. On the other hand, a strong resemblance in appearance between *S. filicinum* and *S. horneri*, in addition to opposite or complex characters in sexuality, led the present authors to investigate the conceptacular development.

The senior author (Okuda 1987) reported a finding in the western Seto Inland Sea of a population of *S. horneri* that became fertile late in the fall instead of the spring—the established time for this population of alga to be fertile. With cylindrical vesicles, these autumnal plants are presently identified with *S. horneri*. Other than the vesicles, however, there are still some features which are in need of examination before reaching a satisfactory identification. In this paper an attempt is made to compare these algae with *S. horneri* from a viewpoint of conceptacular development.

Materials and Methods

Material of *Sargassum filicinum* was collected at the mouth of Omura Bay, near Sasebo, Nagasaki Pref., on May 8 and June 7, 1986. Plants were abundant on both these days and each sample turned out to be successful for this study. Plants with small receptacles were dominant on May 8, but only a few on June 7 were found. Samples of autumnal *S. horneri* were collected near the shores of Yanai, Yamaguchi Pref., on October 15, 1986. Sterile plants were then dominant, and 40–50% of the vegetation seemed to form small receptacles.

An apical section 2–3 mm long of each receptacle was cut from freshly collected thalli and immersed in the fixing fluid (1 g chromic acid, 1 m*l* propionic acid, 90 m*l* of seawater) for about 24 hours. Microtome sections were made from paraffin 6 μm in thickness and stained with Heidenhain's iron haematoxylin.

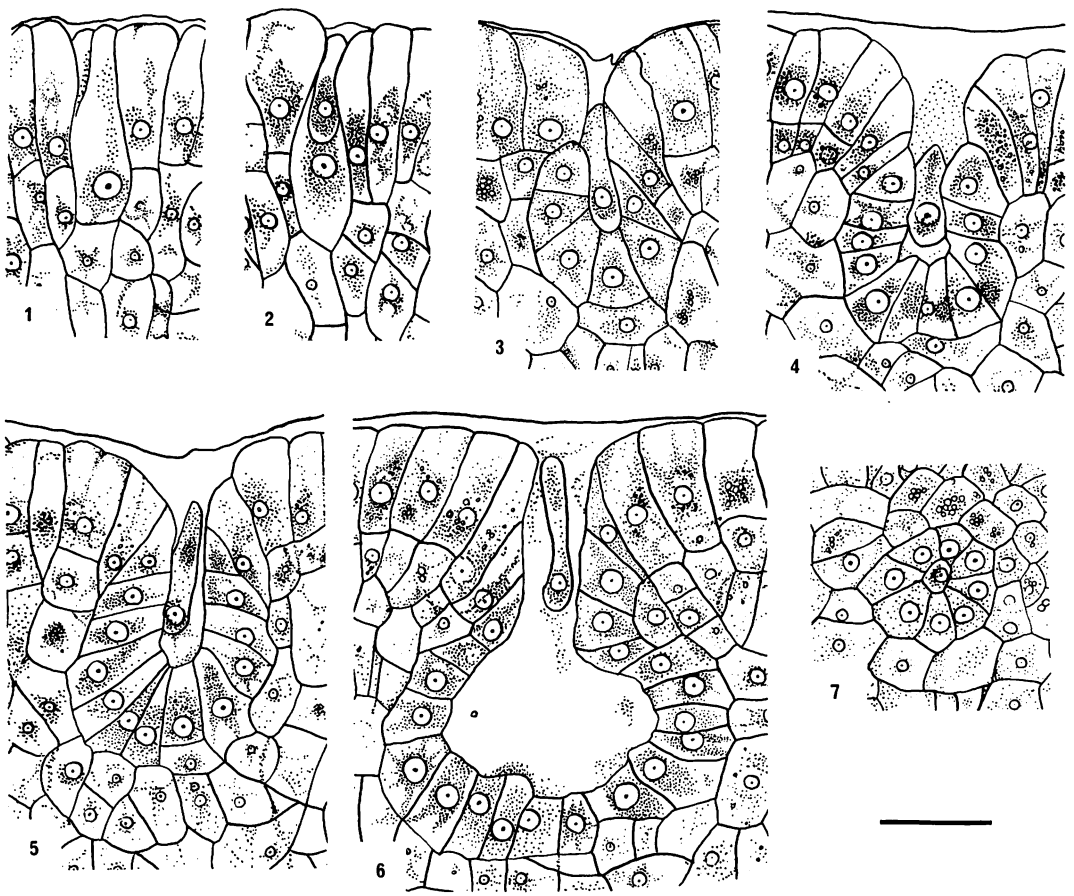
Results

1) *S. filicinum*

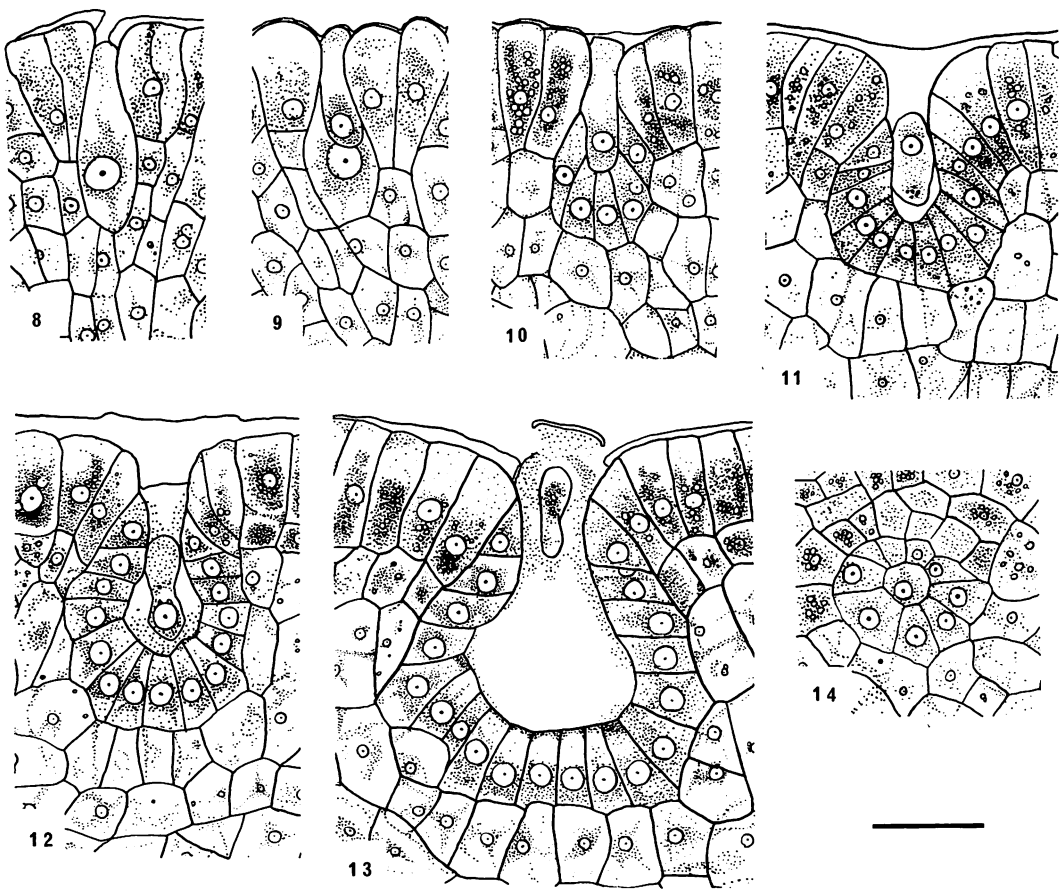
The conceptacle originates from an initial cell which is characteristically flask-shaped and is located near the apical cell of a receptacle (Fig. 1). The initial cell is divided by a downwardly curving transverse wall, thus producing two very dissimilar cells, namely, the tongue cell and the lower cell (Fig. 2). No further divisions occur in the tongue cell. In the lower cell, however, longitudinal divisions continue, and the cells derived from the lower cell partially surround the tongue cell (Fig. 3). Though the tongue cell is firmly attached to these surrounding cells in the early stages, it becomes detached first at its base and is soon transferred to the ostiole (Fig. 4). A mass of mucilage is secreted around the tongue cell, thus leaving a gap between the ostiole and the tongue cell (Fig. 6). In a cross-section through the base of young conceptacles, the conceptacular lining-cells, or the cells derived from the longitudinal divisions of the lower cell, are arranged radially around the tongue cell (Fig. 7).

2) Autumnal *S. horneri*

The development of the conceptacle follows the same process as *S. filicinum* described above. An initial cell is flask-shaped and is located near the apical cell of a receptacle (Fig. 8). The initial cell is divided by a



Figs. 1–7. Conceptacular development in *Sargassum filicinum*. 1. Initial cell. 2. Divided initial cell with tongue cell and lower cell. 3. Longitudinal division of the lower cell. 4. Dislodgement of the tongue cell. 5–6. Further development of the conceptacle. 6. Tongue cell as a loose plug in the ostiole. 7. Cross-section through the base of a young conceptacle with cells radially arranged. Scale bar is 20 μm.

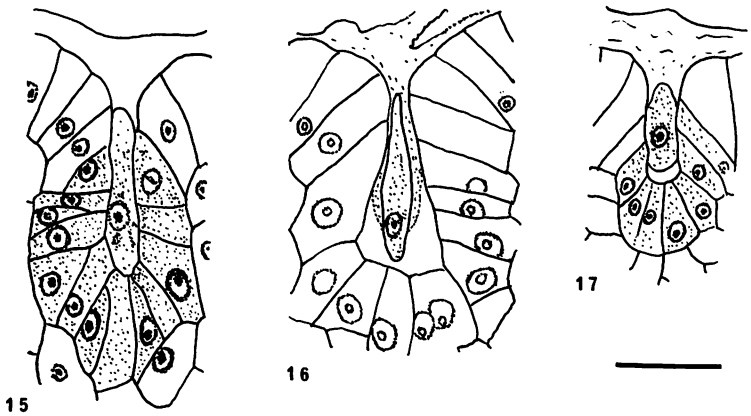


Figs. 8–14. Conceptacular development in autumnal *Sargassum horneri*. 8. Initial cell. 9. Divided initial cell with tongue cell and lower cell. 10. Longitudinal division of the lower cell. 11. Dislodgement of the tongue cell. 12–13. Further development of the conceptacle. 14. Cross-section through the base of a young conceptacle with cells radially arranged. Scale bar is 20 μm.

downwardly curving transverse wall to produce two unequal cells, namely, the tongue cell and the lower cell (Fig. 9). No further divisions occur in the tongue cell. In the lower cell, on the other hand, longitudinal divisions continue, and there is no space between the tongue cell and the derived cells from the lower cell in the early stages (Fig. 10). The tongue cell, however, becomes detached first from the inner wall of the conceptacle at its base and is shortly after transferred to the ostiole (Fig. 11). A mass of mucilage is secreted around the tongue cell, thus forming a gap between the ostiole and the tongue cell (Fig. 13). In a cross-section through the base of young receptacles, the conceptacular lining-cells, or the cells derived from the longitudinal divisions of the basal cell, are arranged radially around the tongue cell (Fig. 14).

Discussion

The present concept of the conceptacular development in the Fucales was first introduced by SIMONS (1906) on *Sargassum filipendula*. According to her designation, she showed that an initial cell is unequally divided to produce a tongue cell and a lower cell, and that the latter is responsible for the later development of the conceptacle. NIENBURG (1913) studied seven species in seven genera and showed that the mode of the development varies somewhat in these members. FEN-



Figs. 15–17. Young conceptacles around the tongue-cell dislodgement (after Tahara 1940, 1941a). 15. *Sargassum horneri*. 16. *S. enerve*. 17. *S. hemiphyllum*. Scale bar is 20 μm.

SHOLT (1955) employed conceptacular development as one of five characteristics to discuss the *Cystoseira-Cystophyllum* complex. TAHARA (1940, 1941a, b) examined sixteen species in three genera around Japan, namely, *Cystophyllum* (*Myagropsis*), *Sargassum*, and *Coccophora*. According to him, from a viewpoint of the tongue-cell behavior, there are some different paths even in *Sargassum*. Among thirteen species of *Sargassum* dealt with by him, *S. horneri* has attracted attention because of its growing tongue cell.

Based on some characteristics previously reported concerning *S. filicinum* (SAWADA 1955, 1956; OKUDA 1977) and autumnal *S. horneri* (OKUDA 1987; HONDA and OKUDA 1989), the authors surmised that the conceptacular development in these algae would follow the same progress as *S. horneri*. However, as the results show, both algae follow the same pattern as that reported by TAHARA (1940) on *S. enerve* (=*S. fulvellum*). The tongue cell of *S. horneri* enlarges, along with the divisions of the lower cell, in the early stages. According to TAHARA's figure, redrawn in Fig. 15, there is no space between the enlarged tongue cell and the lower-cell derivatives when they number thirteen. The tongue cell becomes detached and transfers to the ostiole some time in the conceptacular development. In *S. enerve* (Fig. 16) and *S. hemiphyllum* (Fig. 17), the tongue cell leaves the base when the derivatives number about ten or earlier. In *S. filicinum* and autumnal *S. horneri*, the tongue cell has already been dislodged when the derivatives number eleven. As far as the number of the derivative cells at the time of the tongue-cell's dislodgement is concerned, thirteen is still early for *S. horneri* and eleven is late for *S. filicinum* and autumnal *S. horneri*. The authors examined *S. horneri* from Tsuyazaki, Fukuoka Pref., and found that the tongue cell is firmly attached to the floor of the conceptacle when the derivatives number eleven.

In more advanced stages, the tongue cell of both algae studied here secretes a mass of mucilage around it, thus leaving a space between the ostiole and the tongue cell. This is also true of *S. enerve*. In *S. horneri*, however, the tongue cell forms a tight plug according to TAHARA (1940). This has been reconfirmed by the present authors as well.

Concerning the tongue-cell behavior when it leaves the floor and clogs the ostiole, the results are quite unexpected because autumnal *S. horneri* follows a different path than that of *S. horneri*. The authors will study this unexpected behavior further to find if there is a certain range in the cell number of the lower-cell derivatives at the time of the tongue-cell's dislodgement.

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奥田武男・佐藤由香利：シダモク及び秋に成熟するアカモクの生殖器巣形成

春秋別べつに成熟するアカモクの2群のうち秋に成熟する1群，及びシダモクにおける生殖器巣の初期形成過程を調べ，すでに報告されている標準的な春のアカモクの場合と比較した。始原細胞が舌状細胞と下位細胞に不等割すること，下位細胞のみが分裂を続けて生殖器巣の内壁を形成して行くこと，舌状細胞はやがて基部から離れて巣口に移ること，下位細胞の分裂によって新成された細胞は，舌状細胞を中心に放射状に配列されること等は3者とも同じである。しかし今回取上げた2者では舌状細胞の離れる時期が早いこと，舌状細胞が巣口でアカモクのようには固い栓状とならず，粘液を分泌してゆるい栓状となること等は，ホンダワラでの結果と同じである。（812 福岡市東区箱崎6–10–1　九州大学農学部水産学教室）