sectione verticali conidioma peridermale, pars basalis immersa in textura peridermali, pars cupulata erumpens. Peridium multiseriatum consistens ad basim e textura angulari hyalina vel pallide brunnea cum pariete crasso, lateraliter e textura simili, fusciori, quae transit in texturam porrectam ad peripheriam. Setae presentes in pariete externo conidiomatis, brunneae, rigidae, septatae, levae, praeacutae, pallidiores ad apicem, subacutum, 150–200 × 3.75–4.0 μm. Cellulae conidiogenosae limitantes cavum conidiomatis, dispositae sicut valli, blasticae, hyalinae, leves, cylindratae, 25–30 × 3.5–4.0 μm. Conidia fusiformia, 3-septata, rarissime 4-septata, hyalina, pallide brunnea in massa, cum pariete tenui, levia, recta vel vix curva, saope guttulata, apex obtusus, basis truncata, 45–48 (45.8) × 5.0–5.5 (4.8) μm, appendix apicalis, terminalis, filiformis, non-ramosa, 11.5–14.0 μm longa, appendix basalis excentrica, filiformis, non-ramosa, brevior quam appendix apicalis, 7–8 μm longa.

Habitat: in ramulis decisis mortuis *Eugenia jambolana.* collectis in Tambaram, in campo Madras Christian College, 13.3.84 a J. Muthumary, Herb. MUBL. 2873; the specimen has also been deposited in HCIO, IARI, New Delhi.

The author is grateful to Rev. Fr. V. Dierckx, St. Albert's College, Ranchi for kindly translating the diagnosis of the new species into Latin. Grateful thanks are due to Professor C. V. Subramanian, former Director, Centre of Advanced Study in Botany, University of Madras for his encouragement.

3 October 1985; Revised 5 December 1985

STUDIES ON *STOECHOSPERMUM MARGINATUM* (C.AG.) KÜTZ. (DICTYOTALES, PHAEOPHYTA)

R. RENGASAMY,

Centre of Advanced Study in Botany, University of Madras, Madras 600 025, India.

THE brown alga *Stoechospermum marginatum* (C.Ag.) Kütz occurs on the Indian coast[1]. Preliminary studies on this species drew attention to the involute apical portion as in *Padina* and the occurrence of paraphyses along with the reproductive bodies as in *Zonaria*[3]. In the present report certain interesting observations are made on the occurrence of indusium in female gametophyte and the *in situ* germination of the spores.

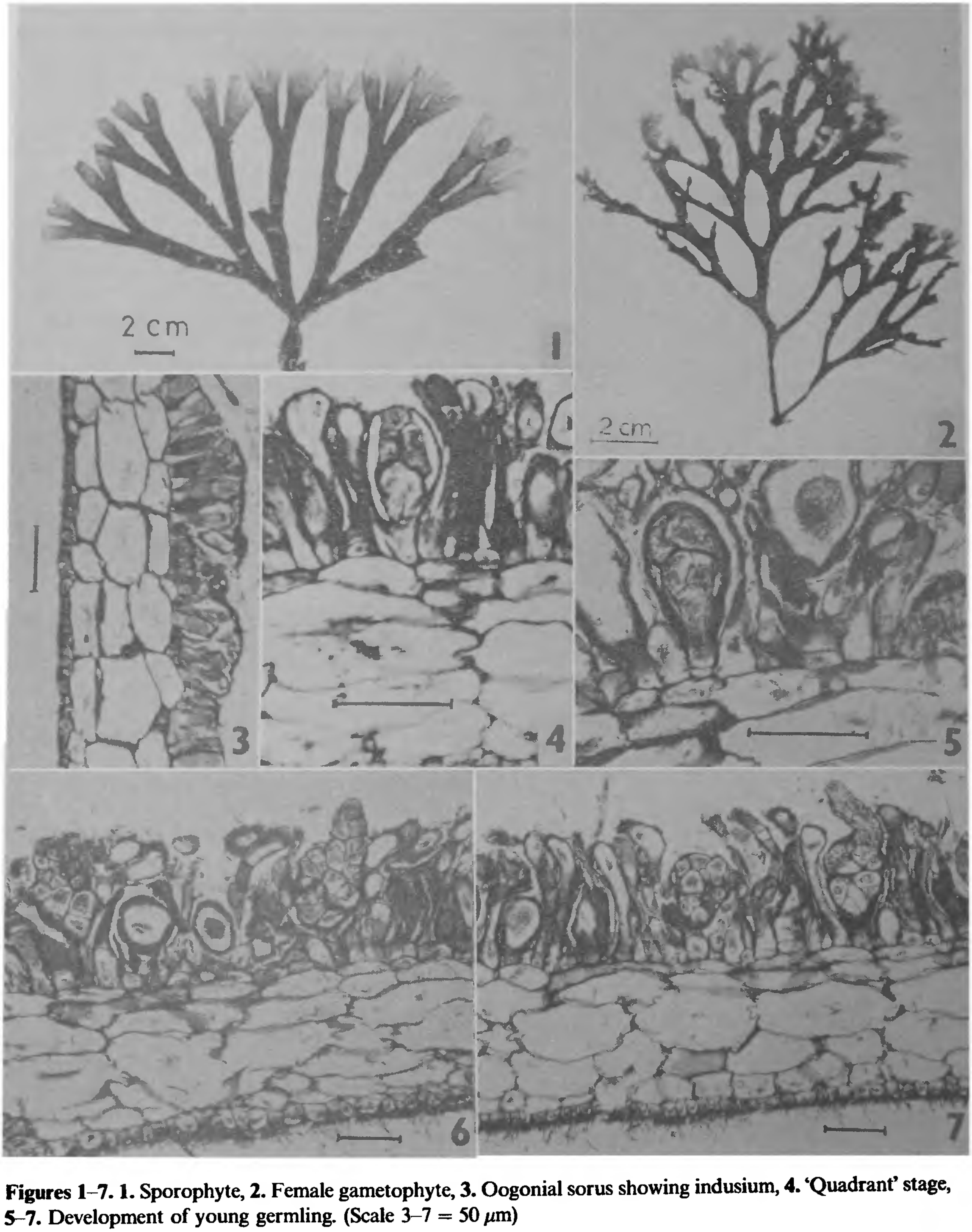
Specimens of *S. marginatum* (both sporophyte and female gametophyte) were collected from Mandapam, South India, during April 1984 at a depth of 0.1–1.0 m at low spring tide and preserved in Navashin fixative for microtomy[4]. Serial microtome sections (L.S.) were stained with hematoxylin and erythrosin.

Morphology: Plants (sporophyte and female gametophyte) are yellowish brown in the apical portion and dark-brown in the older portion. The height of the sporophyte and female gametophyte was 15–20 cm and 10–15 cm; the width of the divided parts of the thallus was 1.0–1.5 cm and 0.5–1.0 cm respectively (figure 1,2). The thallus is sharply differentiated by irregular dichotomy, marginal patches of reproductive organs always found mingled with paraphyses, hairs represented in bundles and scattered throughout and the apical involute portion[1,3].

Observations on the anatomical features of the serial microtome sections of the thallus revealed certain interesting points.

Oogonia: The oogonial sori occur in the form of elongated patches along the upper (dorsal) and lower (ventral) surface of the thallus. The superficial cells of the thallus function as oogonial initials. Each initial divides transversely into the lower stalk cell and the upper oogonial cell. Each oogonium (50–75 μm long and 35–50 μm broad) produces a single egg. Both the paraphyses and oogonia are covered by a common sheath, the indusium. This indusium is generally derived from the outer wall layers of the oogonia as well as paraphyses[5]. Illustrations of the thallus of *S. marginatum* from India[1] have shown the oogonia without indusium. In *S. marginatum* tetrasporangia are the ones without indusium and the oogonia certainly possess indusium. The mature eggs are usually released by the rupture of the oogonial wall and the indusium on the upper side (figure 3).

In situ germination: In *S. marginatum* large and small spores (tetraspores) are liberated and the stages of early germination and the development have been reported[6]. In the present investigation large spores showed *in situ* germination. Contents of each mature spore undergo both vertical and transverse divisions forming a 'quadrant' stage (figure 4) and latter by irregular divisions attain the 'central nodule' stage. Any cell on the upper side of the 'central nodule' protrudes and cuts off the apical cell. This cell divides in three planes (transverse, vertical and anticlinal) resulting in a



Figures 1–7. 1. Sporophyte, **2.** Female gametophyte, **3.** Oogonial sorus showing indusium, **4.** 'Quadrant' stage, **5–7.** Development of young germling. (Scale 3–7 = 50 μm)

young germling without rhizoid. Spore germinating *in situ* showed stages of germination similar to liberated spores[6-8] (figures 5–7). These germlings may detach and develop into either the same parental generation[9] or the sexual plants[10].

The author is thankful to the UGC for financial assistance.

8 October 1985; Revised 7 December 1985

1. Misra, J. N., *Phaeophyceae in India*, 1966, ICAR, New Delhi 203 pp.
2. Krishnamurthy, V., and Joshi, H. V., *A check list of Indian Marine algae*, 1970, C.S.M.C.R.I., Bhavnagar 11.
3. Papenfuss, G. F., *Bull. Jpn. Soc. Phycol.*, 1977, **25**, 271.
4. Johansen, D. A. *Plant microtechnique*, 1940, McGraw-Hill, Company, New York & London 523 pp.
5. Thivy, F., *J. Mar. Biol. Assoc. India*, 1959, **1**, 69.
6. Wevers, I. M. and Mshigeni, K. E., *Bot. Mar.*, 1979, **22**, 289.
7. Carter, P. W., *Ann. Bot.*, 1927, **41**, 139.
8. Srinivasan, K. S., *Bull. Bot. Surv. India*, 1960, **2**, 429.
9. Robinson, W., *Ann. Bot.*, 1932, **46**, 113.
10. Nishibayashi, T., and Inoh, S., *Bot. Mag. Tokyo*, 1959, 261.

IN VITRO STUDIES OF SPIKE DISEASE OF SANDAL (*SANTALUM ALBUM* L.)

A. N. S. GOWDA and R. NARAYANA
College of Basic Sciences and Humanities,
Gandhi Krishi Vignana Kendra,
University of Agricultural Sciences,
Bangalore 560 065, India.

SANDAL spike is a serious disease taking heavy toll in all the sandal growing States of South India, *viz* Karnataka, Tamilnadu and Kerala. The disease has been the subject of interest for more than a century and has been recently reported to be caused by mycoplasma[1,2]. *In vitro* propagation of sandal is attempted by some workers[3-5]. We have made an attempt to culture the healthy and spiked tissues of sandal, using internodal segments as explants.

Young twigs of both healthy and diseased plants were collected from Bannerghatta Reserve Forests of Bangalore district. Defoliated stem pieces were surface-sterilized by washing with liquid carbolic soap several times followed by 0.1 % $HgCl_2$ for 5 min and 50% (v/v) of NaOCl with a few drops of 'Tween-20' (detergent) for 15–20 min. Finally they were thoroughly washed with sterile double-distilled water several times to remove the traces of disinfectants. The surface-sterilized stem pieces were cut into approximately, 1 cm long 'cylinders' and transferred aseptically to flasks (4 pieces each) containing 25 ml of Murashige and Skoog's[6] (MS) or White's[7] basal media supplemented with growth regulators at varying concentrations and combinations.

Segments from healthy plants showed callus initiation in 6–8 weeks after culture, on both MS and White's basal media supplemented with 2,4-dichlorophenoxyacetic acid (2,4-D) (0.1 mg/l) and benzyl adenine (BA) or kinetin (1.0 mg/l) (figure 1). Further growth of the callus was relatively better on MS medium in comparison with White's basal medium. The callus eventually differentiated into embryoids on the same media (figure 3). Spiked segments failed to grow on these media supplemented with 2,4-D and BA or kinetin; instead the callus initiation was seen when the basal media were supplemented with 2 to 5 mg/l of gibberellic acid (GA_3) in addition to 2,4-D and BA or kinetin. Addition of GA_3 to the media did not have any effect on the healthy segments in the initiation of the callus (figures 1, 2). In the diseased tissue the differentiation of callus into embryoids occurred only in the presence of GA_3 (figures 3, 4).

The difference in the response of diseased and healthy segments with respect to callus formation and further differentiation is attributed to the deficiency in the endogenous contents of the growth regulators, particularly gibberellic acid in the spike tissue. Indeed, reduced amounts of endogenous GA_3 content was reported in some viral[8,9] and fungal diseases[10,11]. Further, the symptoms of the disease such as internodal shortening, yellowing (chlorosis) of leaves, reduction in the size of leaves, inhibition of flowering (phyllody), accumulation of starch are comparable to the deficiency symptoms of GA_3. Besides, preliminary trials in our laboratory revealed that the exogenous application of GA_3 to the diseased plants resulted in the recovery of the plants to some extent. It would be interesting to confirm the presence of MLO bodies electron microscopically in such induced callus and regenerated plants.