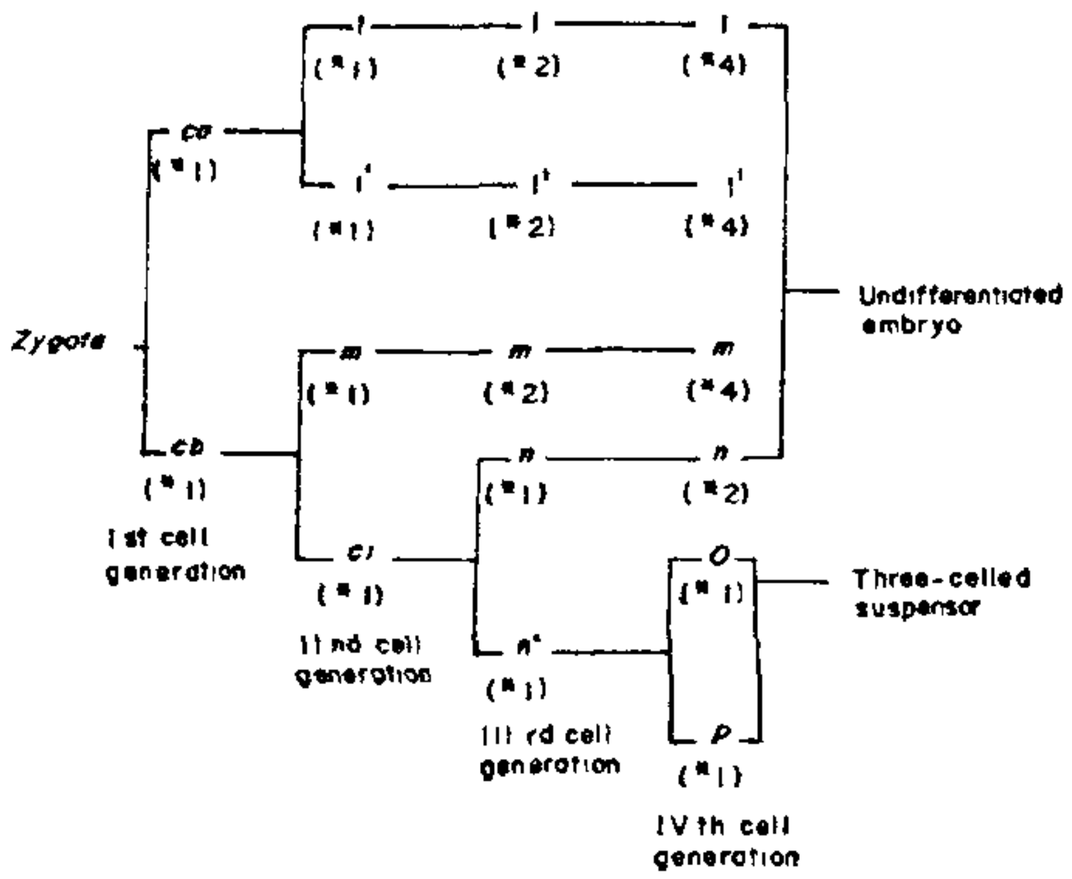
capitulated by the divisional sequence at early stages of embryogeny as given below:



Our observation on the principal type of embryogeny concurs with that of the earlier workers[7]. However, more work on this species collected from several places is really desirable before one confirms or refutes the report of the occurrence of T-shaped proembryonal tetrad besides the linear ones, tending toward the genesis of Onagrad type of embryogenesis[7].

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TRENDS OF SPECIALIZATION IN ENDOSPERM OF THE CYPERACEAE

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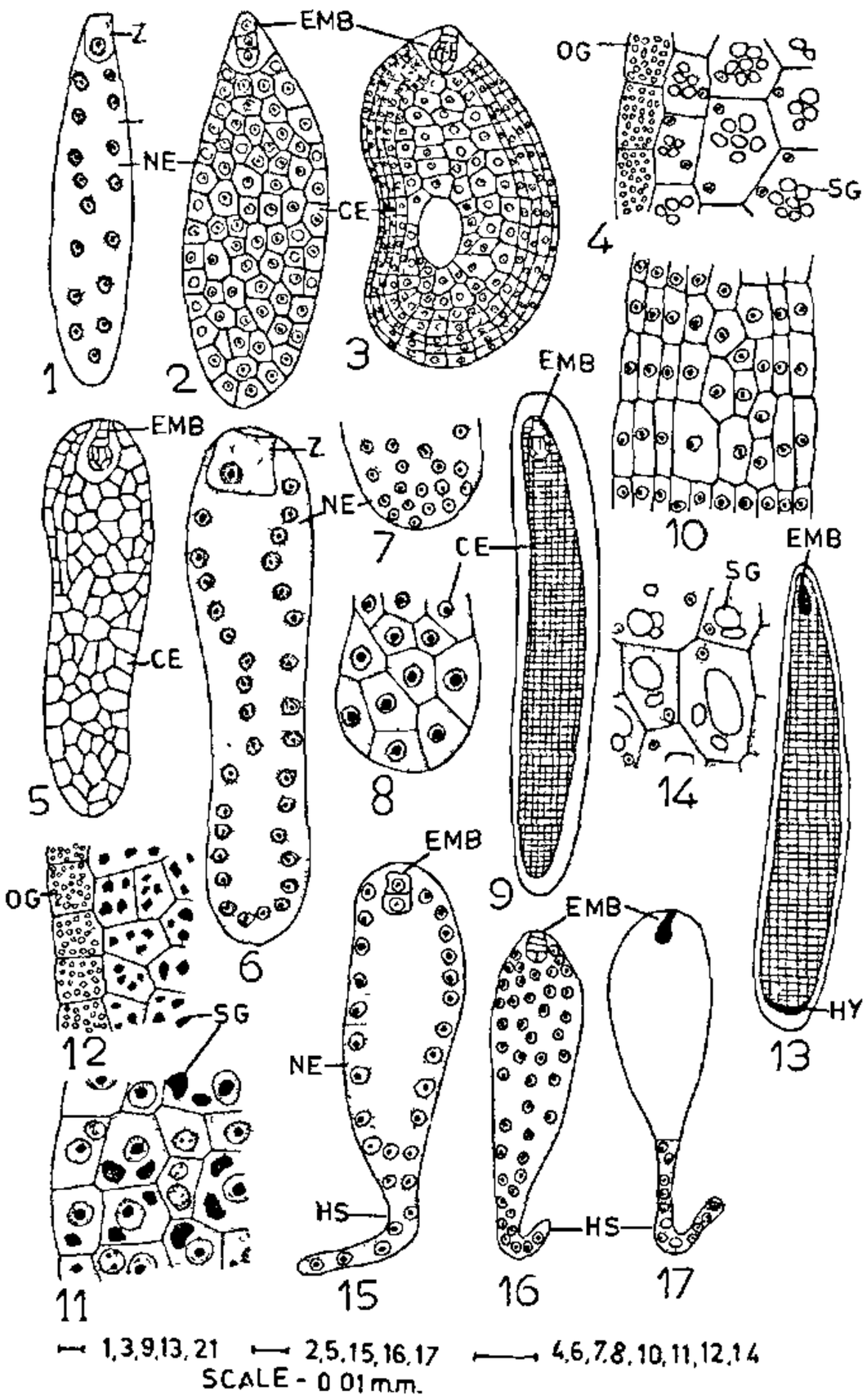
THE endosperm development in the Cyperaceae is *ab initio* free nuclear. This is the uniform pattern observed in the family[1–6]. The present study in 10 taxa (*Pycreus pumilus* Nees., *Cyperus alternifolius* Willd., *Mariscus paniceus* Vahl. *Eleocharis atropurpurea* Kunth., *Fimbristylis cymosa* R. Br., *Scirpus supinus* Linn., *Eriophorum comosum* Wall., *Fuirena ciliaris* Linn., *Remirea maritima* Abul., *Scleria lithosperma* Roxb.) confirmed the above findings. Customary methods of microtomy were followed.

The variation has been observed in the number of endosperm nuclei at zygote stage (figures 1–6). During embryogenesis endosperm nuclei are evenly distributed except in *Eriophorum comosum* where at chalazal end they form a dense mass. Later, cellularization occurs in this region and it becomes well marked from the remaining part (figures 7, 8). However, there is no formation of endosperm nodule.

The free nuclear stage is replaced by cellular one. The variation has been recorded regarding the onset of cellular stage in the taxa investigated. At one end of the series are species like *Scleria stoksiana*[7] and *S. lithosperma* (present work) where cellularization sets in at the bicelled stage of the proembryo (figures 15–17). In *Pycreus pumilus* and *Cyperus alternifolius* it becomes cellular at the proembryonic tetrad stage. Occasionally this event may occur at 3-celled stage in *Cyperus alternifolius* (figure 2) a condition reported in *Pycreus puncticulatus, Kyllinga triceps,*[8] and *Fimbristylis quanguangularis*[3]. Next in order fall taxa like *Fimbristylis cymosa, Scirpus supinus* and *Remirea maritima*, where at the third cell generation wall formation is completed. This has been reported in *Cyperus alopecuroides*[4] and *Kyllinga brevifolia*[6]. At the other end of the series one can visualise majority of the investigated members where wall formation is completed only at the close of the fourth cell generation when dermatogen initials are cut off in the proembryo[2, 5, 7]. In the present work such a condition is observed in *Eleocharis atropurpurea* (figure 3), *Scirpus supinus* (figure 5), *Eriophorum comosum*, and *Fuirena ciliaris.*

After the onset of the cellular phase the endosperm increases in bulk during the maturation of the seed. The two trends can be visualised to indicate the increase in bulk. In the majority of the taxa it is



Figures 1–17. Endosperm in the Cyperaceae **1.** *P. pumilus* Nees. **2.** *Cyperus alternifolius* Willd. **3.** *Eleocharis atropurpurea* Kunth. **4.** *Fimbristylis cymosa* R. Br. **5.** *Scirpus supinus* Linn. **6–10.** *Eriophorum comosum* Wall. **11, 12,** *Fuirena ciliaris* Linn. **13, 14.** *Remirea maritima* Abul. **15–17.** *Scleria lithosperma* Roxb. [1, 6, 7, 15–17 various stages in development of free nuclear endosperm, (note endosperm haustorium in 15–17); 2, 3, 5, 9, 13, cellular endosperm (note meristamatic activity in 3). 4, 11, 12, 14 A part of endosperm showing oil globules and starch grains. 8. Chalazal part of cellular endosperm. 10. Part of 9. (CE = Cellular endosperm, EMB = Embryo, HS = Haustorium, HY = Hypostase, NE = Nuclear endosperm, OG = Oil globules, SG = Starch grains, Z = Zygote)]

accomplished by repeated divisions followed by cytokinesis in the bulk of endosperm[2, 6, 8, 9]. This is further substantiated by the present work in *P. pumilus, C. alternifolius, Mariscus paniceus, Fimbristylis cymosa, Scirpus supinus* and *Remirea maritima*. The plants like *E. atropurpurea, Eriophorum comosum, Fuirena ciliaris* and *Scleria lithosperma* (figures 15–17) studied here; and in *Rhynchospora wightiana* and *Scleria stocksiana*[7], there ensues a distinct meristimatic activity in the superficial layers of endosperm which adds to its bulk. Details about this aspect in the family are not available for a large number of members. As such, on the basis of the present inadequate knowledge, it is difficult to visualise which of these methods is of later origin in the family.

In *Scleria lithosperma*, wall formation in the chalazal region is absent and the endosperm remains free nuclear for a long time till the initiation of plumule, and thus forms a sort of weakly developed tubular haustorium at the base (figures 16, 17). Similar condition has also been recorded in *S. stocksiana*[7] and *Cyperus iria*[5].

In the taxa investigated here, the cells are uninucleate during cellularization; but at later stages of development the cells become multinucleated because divisions are not accompanied by cytokinesis (figures 4, 11). A similar condition has been reported in *Cyperus iria, Kyllinga brevifolia* and *K. triceps*[5, 6].

In mature condition, the bulk of the endosperm is studded with starch grains while the superficial layer is filled with oil globules to form the oil sheath of the endosperm. They are normally polygonal and crossed together in clumps as in *Mariscus paniceus, Fimbristylis cymosa, Fuirena ciliaris* and *Remirea maritima* (figures 4, 9, 11–14). This is also reported in *Cyperus iria* and *K. brevifolia*[5, 6]. They may be globular or spherical as in *Scirpus supinus* and *Fuirena ciliaris* and also in *Fimbristylis miliacea* and *F. falcata*[10].

Khanna[2] described the endosperm as ruminate because of the uneven outline of the inner wall of the seedcoat. However, the uneven outline of endosperm is rather superficial and the ingrowths caused by the inner layer of seedcoat are not deep. It is debatable whether such superficial ingrowth can render the endosperm ruminate. Periaswamy[11] does not mention Cyperaceae amongst the families possessing ruminate endosperm.

The seeds of the sedges are endospermous and mature embryo is embedded in it. The Gramineae, too, has endospermous seeds, the embryo is situated on one side. This character has been used as one of the evidences for segregating the sedges from the grasses and treating them as distinct orders not related to each other.

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ELICITATION OF MOMILACTONE BY GIBBERELLINE IN RICE

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INVOLVEMENT of momilactone in disease resistance of rice cultivars has been previously reported[1–3]. In this communication, elicitation of momilactone by gibberelline in healthy coleoptiles and leaf sheaths of rice and stimulation of momilactone biosynthesis in GA_3-treated and untreated infected tissues is reported.

The selection of the rice cultivar for the study was based on its responses to *Acrocylindrium oryzae*, the causal fungus of sheath rot disease. Earlier pathogenicity test of *A. oryzae* on different rice cvs. revealed that tall cvs. particularly Mahsuri, Rupsail, Badkalamkati were resistant while semidwarf ones *viz* Jaya, IR-8, CR-126-42-1 were susceptible to sheath rot[4]. A susceptible cv. (Jaya) was, therefore, chosen to induce resistance by chemical activation of host defense mechanism. Different concentrations (0.1, 1, 10 and 100 ppm) of GA_3 solution were sprayed on 9-week old rice plants (cv. Jaya) grown in earthen pots containing soil compost, twice at an interval of 4 days and inoculated with spore suspension (8×10^6 spores/ml, 1 ml/leaf sheath) after 3 days of the second spray. Control plants were sprayed with sterile distilled water. The replicate pots (4 plants/pot) were taken for each treatment and the disease intensity was assessed 21 days after inoculation following the method of Raychoudhuri and Purkayastha[5]. The results showed that susceptibility of plants decreased when treated with GA_3 (10 and 100 ppm). The disease indices (DI/leaf sheath) were 6.50 and 1.57 for control and treated (100 ppm) plants respectively. Again, when 10 ppm of GA_3 solution was sprayed on dark grown coleoptiles and inoculated with *A. oryzae*, the roots became brown after 48 hr of incubation while the control (uninoculated, treated) roots remained white.

Mimilactone was extracted from both treated and untreated coleoptiles following the method of Cartwright *et al*[2] with modifications[1]. The fractions obtained from Sephadex LH-20 column were evaporated to dryness and the residue in each case was dissolved in 1 ml. of 95% ethanol. Aliquots of each fraction were applied separately on TLC plates (silica gel G, BDH), developed in chloroform – ethanol (97:3) solvent system, dried and sprayed with a mixture of vanillin – H_2SO_4. The R_f value of the authentic sample (momilactone A) was compared with the isolated momilactone A. Spectral analyses of samples were also carried out for quantification of momilactone. For extraction of momilactone untreated leaf sheaths and GA_3 (100 ppm) – treated leaf sheaths (cv. Jaya) were excised 3 days after second spray, inoculated with spore suspension and incubated for 48 hr. Two hundred grams of infected leaf sheaths (both treated and untreated) were extracted for momilactone following the method as described. The fractions containing momilactone (detected by chemical method) obtained from Sephadex LH-20 column was dried on to activated celite 545 (600 mg) and applied to a column of silica gel in hexane. The

Table 1 *Effect of GA_3 on momilactone 'A' level in rice cv. Jaya*

Treatment	Plant part	Concentration of momilactone (as μg momilactone A/g fresh wt. of tissue)	
		Healthy	Infected
Untreated	Coleoptile	0	5.59
Treated (10 ppm GA_3)	Coleoptile	13.20	16.70
Untreated	Leaf sheath	0	8.64
Treated (100 ppm GA_3)	Leaf sheath	14.54	19.90