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A Contribution to the Embryology of Dilleniaceae

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Introduction

Dilleniaceae is chiefly an australasian and tropical american family with herbs, shrubs and trees. The two arborascent genera like *Dillenia* and *Wormia* are present in South India and Ceylon respectively. The former is very common in the western ghats of Mysore State, India, well represented by *D. pentagyna* and *D. indica.* Many species of Wormia are present in Ceylon. Gilg and Werdermann (1925) include both the genera under the fourth sub-order of the family *Dillenieae,* in 'Die naturlichen Pflanzenfamilien'. The earlier literature on the embryology of this family shows that three genera have been investigated so far; Schnarf (1924) on *Hibbertia dentata,* Paetow (1931) on *Wormia Suffruticosa,* and Swamy and Periasamy (1955) on *Acrotrema arnottianum.* The present investigation deals with the gametophyte development of *Wormia burbidgei* Hook, and *Dillenia pentagyna* Roxb. About the latter a brief note has already been published by Nagaraja Rao (1955).

Materials and Methods

The material of *W. burbidgei* was collected in the Royal Botanic Gardens, Peradeniya, Ceylon; and *D. pentagyna* in the Agumbe range of Western Ghats, Mysore State, South India. They were fixed in Formalin acetic alcohol. Sections were cut at a thickness of 10-16 microns and stained in iron haematoxylin, followed by a counter stain of erythrosin in clove oil. Iodine test was conducted to observe the starch grains. Much difficulty was experienced in sectioning the material of Wormia due to the deposition of tannin and other dark staining bodies in almost all parts of the flower.

Observations

Microsporogenesis and male gametophyte: The stamens are indefinite in number in both the members, and the anthers are elongated with short filament. The anther lobes extend almost the entire length of the stamen and the connectives are pointed. The transection of the young anther lobe shows a plate of four hypodermal archesporial cells (Fig. 1) in both the forms. They divide periclinally to form the primary parietal layer and primary sporogenous

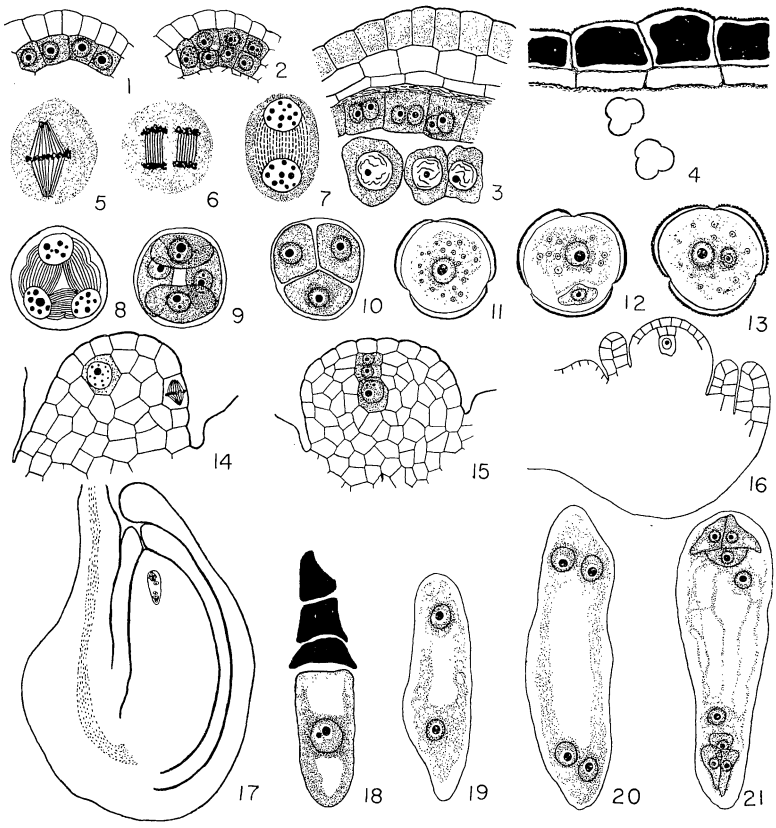

Plate 1. Figs. 1-21. *Wormia burbidgei.* Fig. 1. T.S. part of another lobe showing archesporium. x 334. Fig. 2. Primary parietal and sporogenous layers. x 334. Fig. 3. Stage in the development of anther wall. x 334. Fig. 4. Same at the stage of dehiscence. x 260. Figs. 5-7. Stages in the development of pollen grain. x 1000. Fig. 8. Formation of a tetrad. x 1000. Figs. 9-10. Decussate and tetrahedral tetrads. x 1000. Figs. 11-12. One and two nucleate pollen grains. x 1000. Fig. 13. Mature pollen grain. (note the starch grains) x 1000. Fig. 14. L.S. young nucellus showing primary archesporial cell. x 334. Fig. 15. Primary parietal cells and megaspore mother cell. x 334. Figs. 16-17. Development of ovule. x 167, x 67. Fig. 18. Linear tetrad. x 1000. Figs. 19-21. Two, four and eight nucleate embryo sacs. x 1000.

layer (Fig. 2). The former undergoes further periclinal divisions to form the wall of the anther, while the sporogenous cells after a few divisions become spore mother cells. In both the species the wall of the young anther is made up of epidermis, endothecium, two middle layers and the tapetum. The latter is uninucleate to begin with, but later becomes binucleate and it is of the glandular type (Figs. 3, 22-24).

The microspore mother cells undergo the reduction divisions (Figs. 5-7) and form tetrads of microspores. Quadripartition of the microspore mother cells takes place by centripetal furrowing (Fig. 8) and tetrahedral and decussate tetrads are formed (Figs. 9, 10). The

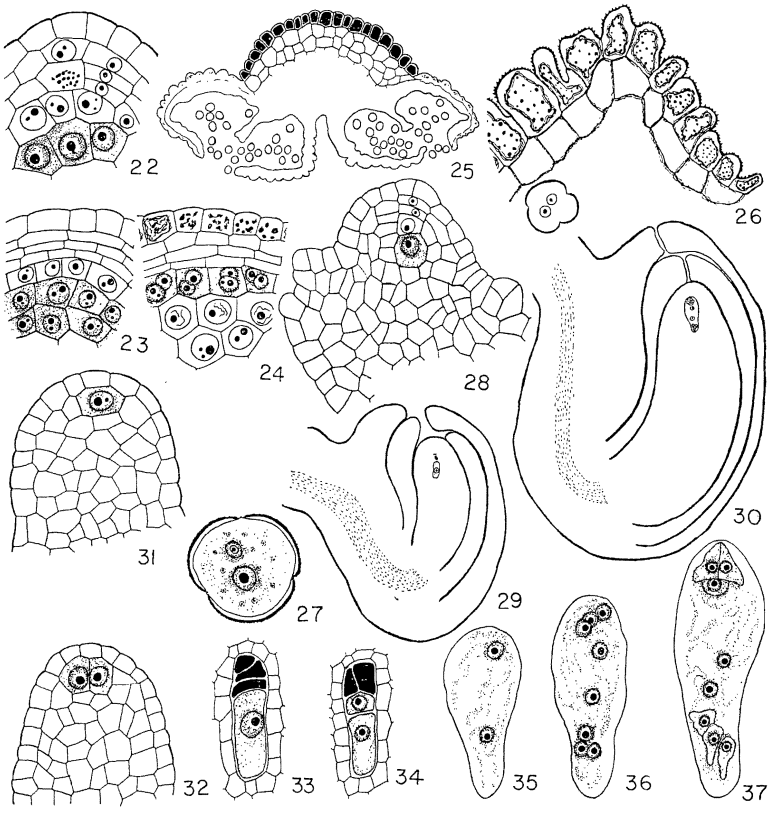

Plate 2. Figs. 22-37. *Dillenia pentagyna*. Figs. 22-24. T.s. of anther wall at different stages of development. x 500, x 334, x 334. Fig. 25. T.S. of anther at the time of dehiscence. x 67. Fig. 26. A portion of the same enlarged to show the epidermis. x 334. Fig. 27. Mature pollen grain. x 1000. Figs. 28-30. Stages in the development of the ovule. x 67. Fig. 31. L.S. young nucellus showing primary archesporial cell. x 334. Fig. 32. Double archesporial cells. x 334. Figs. 33-34. Linear and 'T' shaped megaspore tetrads. x 334. Fig. 35. Two nucleate embryo sac. x 334. Fig. 36. Eight nucleate embryo sac before organisation. x 334. Fig. 37. Organised eight nucleate embryo sac. x 1000.

centrally situated nucleus of the young microspore is surrounded by dense cytoplasm (Fig. 11). The nucleus moves to the periphery and divides to produce a small lenticular generative cell and a large tube cell (Fig. 12). The former moves to the center and thus the pollen grains are two celled at the time of shedding (Figs. 13-27). Paetow (1931) has observed large crystals in the pollen grains of *W. suffruticosa,* both in the uninucleate and binucleate stage. According to him they dissolve in dilute acetic acid and stain with eosin and red through Millon's reagent. In the fixed and sectioned material of *W. burbidgei* no such crystal is seen and perhaps it might have dissolved in the acetic acid contained in the fixative. On the other hand in both the forms under investigation many pollen grains contain starch grains both during their development (Figs. 11-12), as

well as at the time of shedding (Figs. 13, 27). However, in a few preparations of *W. burbidgei* in the mature pollen grains large vacuoles are present, perhaps indicating the space occupied by a crystal.

The mature anther wall consists of only two layers of cells, epidermis and the endothecium. In case of *W. burbidgei* the cells of the epidermis are filled with tannin from the very early developmental stages; whereas in *D. pentagyna* plenty of dark staining globular bodies are present. These persist even in the mature anther wall thus making it very conspicuous (Figs. 4, 25-26). The persistance of such a prominent epidermal layer in the mature anther wall is recorded in *A. arnottia num* by Swamy and Periasamy (1955). Further it is very interesting to note, that in these forms the endothecial cells are nonfibrillar (Figs. 4, 26). The outer surface of epidermal cells have minute outgrowths.

Ovule: The gynoecium is made up of 5-8 carpels in *W. burbidgei* and 5-6 in *D. pentagyna*. They are fused below and free above. The indefinite number of anatropous, crassinucellate, bitegmic ovules are arranged in two regular series. The ovule appears as a conical outgrowth on the placenta. The initials of the outer and inner integument develop when the primary archesporial cell and one or two parietal cells are formed (Figs. 16, 28). In both the forms the outer integument grows faster than the inner (Fig. 29) and grows over the same. In both the species the outer integument is two layered, whereas the inner one is of four layers in *W. burbedgei* and of 3 layers in *D. pentagyna*. At the micropylar region they are many layered and the micropyle is zigzag in outline.

Megasporogenesis and female gametophyte: Within the ovular primordium usually a single hypodermal archesporial cell develops (Figs. 14, 31) though occasionally 2-3 archesporial cells are seen (Fig. 32). They divide to produce a primary parietal cell and megaspore mother cell. By further division of the former a linear row of parietal cells are formed and thus the megaspore mother cell becomes deep-seated (Figs. 15, 28). The megaspore mother cell after undergoing the reduction divisions produces the tetrad of megaspores which may be linear or 'T' shaped in their arrangement (Figs. 18, 33-34). Of these the chalazal megaspore functions and after undergoing two more divisions gives rise to an embryo sac of the polygonum type (Figs. 19-21, 35-37). The mature embryosac is situated in the micropylar region of the ovule on a massive nucellar base (Figs. 17, 30). It is slightly broader at the micropylar end than at the chalazal, and it is elongated. The egg cell lies between both the synergids. The antipodal cells are triangular in outline and lie within the narrower end of the embryosac.

SUMMARY

The development of gametophytes and ovule is described in this paper of *W. budbidgei* and *D. pentagyna*. The wall of the anther is made up of four layers of cells. The tapetal cells are glandular and binucleate. Pollen grains are two celled at the shedding stage. The mature anther wall consists of only epidermis and endothecium. The cells of the latter do not develop any fibrillar thickenings.

The ovary is superior and the carpels are attached at the base and free above. Within each carpel there are two rows of anatropous bitegmic crassinucellate ovules. In both the forms the embryosac develops according to the Polygonum type.

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