STUDIES IN THE FAMILY SAXIFRAGACEAE

V. Structure and Development of the Gametophytes in *Mitella diphylla* L.*

By N. P. Saxena **

School of Plant Morphology, Meerut College, Meerut (India)

(Received for publication on November 1, 1968)

Mitella diphylla, is a pubescent rhizomatious herb. The flowers are pentamerous and perigynous with a turbinate to saucer-shaped floral tube. Some work has already been done in this genus by Dahlgren (1930) and Mauritzon (1933) but these studies were mainly confined to the post-fertilization changes in the genus. The present paper deals with the development of the male and female gametophytes in the above-mentioned plant.

The material of *M. diphylla* was made available for the present study by the curtesy of Dr. Y. S. Murty from his Chicago collection. After usual methods of dehydration and embedding the flowers were sectioned at 10–12 μ and stained with safranin-fastgreen combination.

Microsporangium, microsporogenesis and male gametophyte.—A mature anther is almost squarish in transverse section (Fig. 1). Its wall consists of an outer epidermis, an endothecium, 1–2 middle layers and innermost tapetum (Fig. 2). The cells of the tapetum, at maturity become binucleate and contain dense cytoplasm. Before dehiscence the tapetum and the middle layers degenerate and the endothecium develops characteristic fibrous thickenings (Fig. 3). After separating from each other the microspore mother cells become round (Figs. 4, 5). As a result of gradual enlargement the nucleus fills almost half the space of the cells.

The microspore mother cell undergoes meiosis. Cytokinesis of the simultaneous type (Figs. 6–8). The resulting microspores are arranged in tetrahedral tetrads (Fig. 9) and rarely in decussate manner (Fig. 10). Tetrahedral tetrads have also been recorded in *Parnassia palustris* (Pace, 1912) and *Saxifraga diversifolia* (Saxena, 1964 *a*) and isobilateral tetrads in *Vahlia viscosa*.

---

* Research contribution No.   from the School of Plant Morphology, Meerut.

** Present Address: Department of Botany, D. N. College, Meerut.

The microspores are spherical, become two celled at the shedding stage (Fig. 11). Some sterile pollen grains have also been observed.

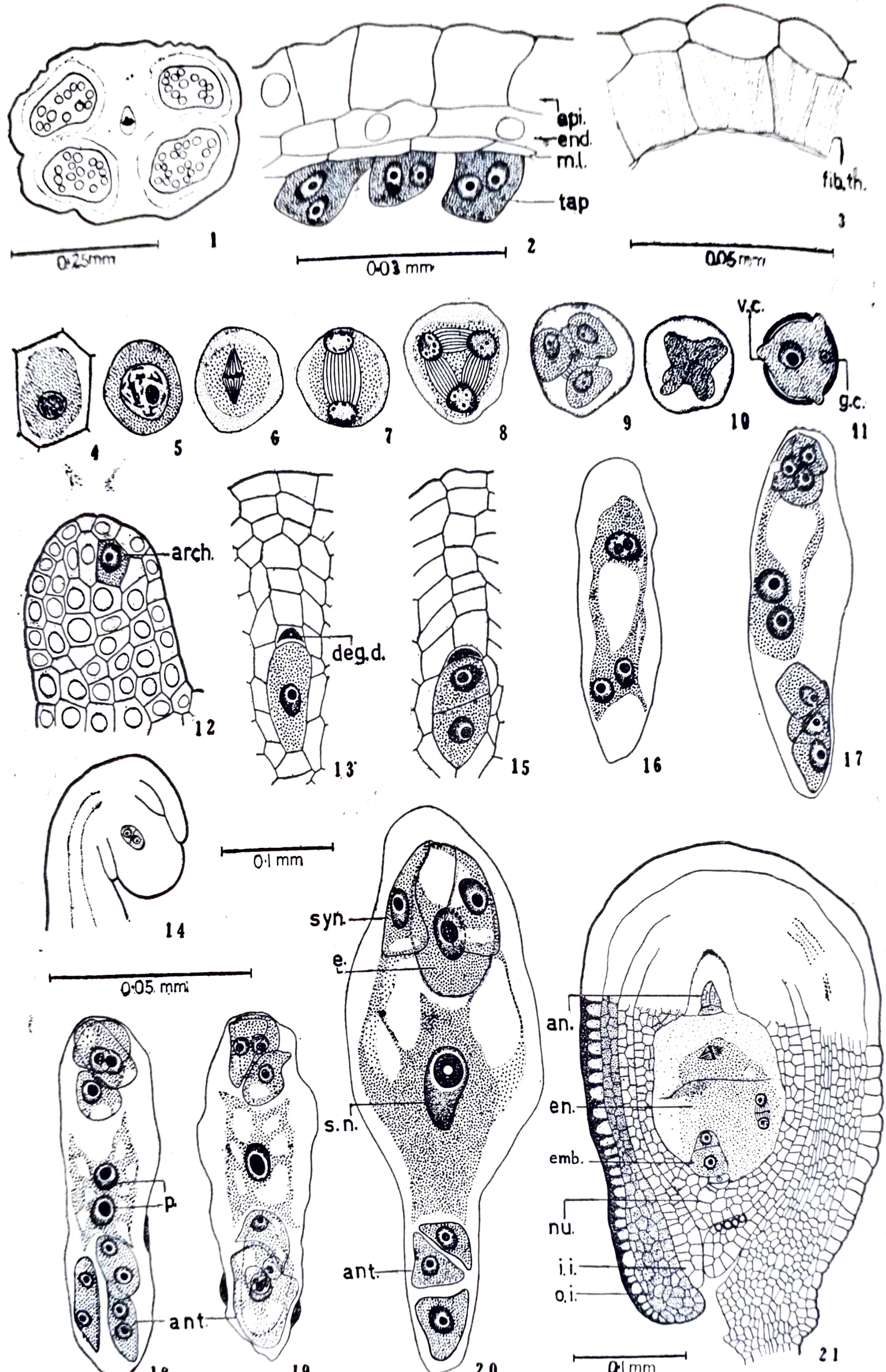
Megasporogenesis and female gametophyte.—The ovules are anatropous bitegmic and crassinucellate. At maturity the two integuments show sharp differentiation (Fig. 21). The hypodermal archesporial cell (Fig. 12), cuts off a parietal cell and as a result of repeated divisions in the latter, the megaspore mother cell lies deep seated in the nucellus: Herr (1954), in *Tiarella cordifolia* describes "archesporial cell differentiated in the centre of the nucellar tissue" but he does not give any illustration for this. It appears that he somehow missed the early stages of development and hence this misinterpretation (*see* Maheshwari, 1950). The megaspore mother cell divides transversely. Generally, the upper dyad degenerates quite early (Fig. 13). The lower dyad divides transversely (Figs. 14, 15).

The nucleus of the chalazal most megaspore divides thrice successively to form eight nuclei, separated by a conspicuous central vacuole (Figs. 16–17). The development of the embryo sac, therefore, corresponds to the *Polygonum* type (Fig. 20). The polars fuse in the centre to form a big secondary nucleus (Fig. 20). The nuclei of the antipodal cells often divide, and therefore, they occasionally become binucleate or even trinucleate (Figs. 18, 19). Binucleate antipodals have also been drawn by Mauritzon (1933) in *Kirengeshoma palmata*. Obviously, this may be taken as a step towards the multiplication of the antipodal cells. Increase in the number of antipodals has also been observed in *Mitella pantandra* (Dahlgren, 1930), *Saxifraga diversifolia* and *Parnassia nubicola* (Saxena, 1964 *a*, *b*). In *P. nubicola* the antipodals also increase in their size. Such a variation of the antipodals, as remarked by Maheshwari (1950) "give an indication of high metabolic activity in these cells and offer a close analogy with the behaviour of the anther tapetum". Johri (1962) also correlated this with the nutrition of the embryo sac.

The tapetum in *Mitella diphylla* is glandular in nature. Its cells become binucleate at maturity. Microspore mother cells show simultaneous type of cytokinesis. Besides tetrahedral tetrads rarely a few decussate ones are also observed.

The ovules are anatropous, bitegmic and crassinucellate. The micropylar dyad is ephimeral. The embryo sac is of *Polygonum* type and develops from the chalazal megaspore. The antipodals sometimes become binucleate or trinucleate.

The author wishes to acknowledge his indebtedness to Dr. Y. S. Murty and Prof. V. Puri for their sincere guidance, helpful criticism and continued interest in the work. He is also thankful to Drs. N. Chandra and V. Singh for their valuable suggestions and to the Ministry of Education for financial assistance.



FIGS. 1–21. *Mitella diphylla*. Fig. 1. T.s. of anther. Figs. 2–3. T.s. of anther wall enlarged showing binucleate tapetal cells in one and fibrous thickening of the endothecium in the other. Figs. 4–9. Various stages in the development of the pollen grains, Fig, 10, A decussate tetrad of sterile microspores.

Fig. 11. Bi-celled pollen grain. Fig. 12. Young ovule showing an archesporial cell. Figs. 13–15. Megaspore dyads and tetrads. Fig. 16. A four-nucleate embryo sac. Figs. 17–19. Young embryo sacs showing normal and multinucleate antipodals. Fig. 20. Organised embryo sac. Fig. 21. A mature ovule with bi-celled embryo.

ant., antipodals; *deg. d.*, degenerated dyad; *e.*, egg; *emb.*, embryo; *en.*, endosperm; *end.*, endothecium; *epi.*, epidermis; *fib. th.*, fibrous thickening; *g.c.*, generative cell; *i.i.*, inner integument; *m.l.*, middle layers; *nu.*, nucellus; *o.i.*, outer integument; *p.*, polars; *s.n.*, secondary nucleus; *syn.*, synergid; *tap.*, tapetum; *v.c.*, vegetati[illegible]

References

DAHLGREN, K. V. O. 1930. Zur Embryologie der Saxifragoideen. *Svensk. bot. Tidskr.* **24**: 429–448.

HERR, J. M. 1954. The development of the ovule and female gametophyte in *Tiarella cordifolia. Am. J. Bot.* **41**: 333–338.

JOHRI, B. M. 1962. Nutrition of the embryo sac. *Proc. Summer School Botany, Darjeeling*, 1960. 106–118.

MAHESHWARI, P. 1950. *An Introduction to the Embryology of Angiosperms.* New York.

MAURITZON, J. 1933. *Studien uber die Embryologie der Familioo Crassulaeeae und sagilragaeeae.* Diss., Univ. Lund.

PACE, L. 1912. *Parnassia* and some allied genera. *Bot. Gaz.* **54**: 306–329.

SAXENA, N. P. 1964 *a*. Studies in the family Saxifragaceae. 1. A contribution to the Morphology and Embryology of *Saxifraga diversifolia* Wall. *Proc. Indian Acad. Sci.* **B 60**: 38–51.

———. 1964 *b*. Studies in the family saxifragaceae. II. Development of Ovule and Megagametophyte in *Parnassia nubicola* Wall. *Ibid.* **60**: 196–202.