

## STUDIES IN MYRSINACEAE

### I. A Contribution to the Embryology of *Maesa dubia* Wall.

BY K. SANKARA RAO

(Department of Botany, St. Joseph's College, Bangalore)

Received June 7, 1971

(Communicated by Prof. L. Narayana Rao, F.A.Sc.)

#### ABSTRACT

*Maesa dubia* (Tribe Maesoideae) of the family Myrsinaceae shows some interesting embryological features. The floral parts arise in acropetal succession. The vascular bundle of each stamen divides in the connective. The tetrasporangiate anthers dehisce by longitudinal slits shedding the pollen at the 2-celled stage. The endothecium and the next layer develop fibrillar thickenings except at the region of dehiscence.

The ovules are anatropous, tenuinucellar and bitegmic. The micropyle is organised by both the integuments. While there is usually a single hypodermal archesporium there is a tendency for the differentiation of multiple archesporium. Only one archesporial cell functions and develops into megaspore mother cell. The tetrad of megaspores is usually linear. Some abnormalities in the sequence of degeneration of the three micropylar megaspores are observed. The development of the female gametophyte follows the *Polygonum* type. A prominent endothelium is differentiated at the dyad stage in the ovule. The chalazal half of the embryo sac forms an aggressive haustorium.

#### INTRODUCTION

EMBRYOLOGICAL investigations on Myrsinaceae are meagre; only few genera were being subjected to investigation in the past and information even on these genera is fragmentary. Literature on earlier embryological studies on Myrsinaceae include those by Hofmeister (1858), Braun (1860), Chatin (1870), Warming (1878), Karsten (1891), Jaensch (1905), Dahlgren (1916), Schurhoff (1926), Carey and Fraser (1932). The present work on the floral ontogeny, anther, ovule and embryo sac development is a part of detailed

investigation on the embryology of *Maesa dubia* and Myrsinaceae in general undertaken by the author.

Myrsinaceae are treated in a small order Primulales together with Theophrastaceae and Primulaceae by Engler (1892). Hutshinson (1959) treats Myrsinaceae under a separate order—Myrsinales.

#### MATERIALS AND METHODS

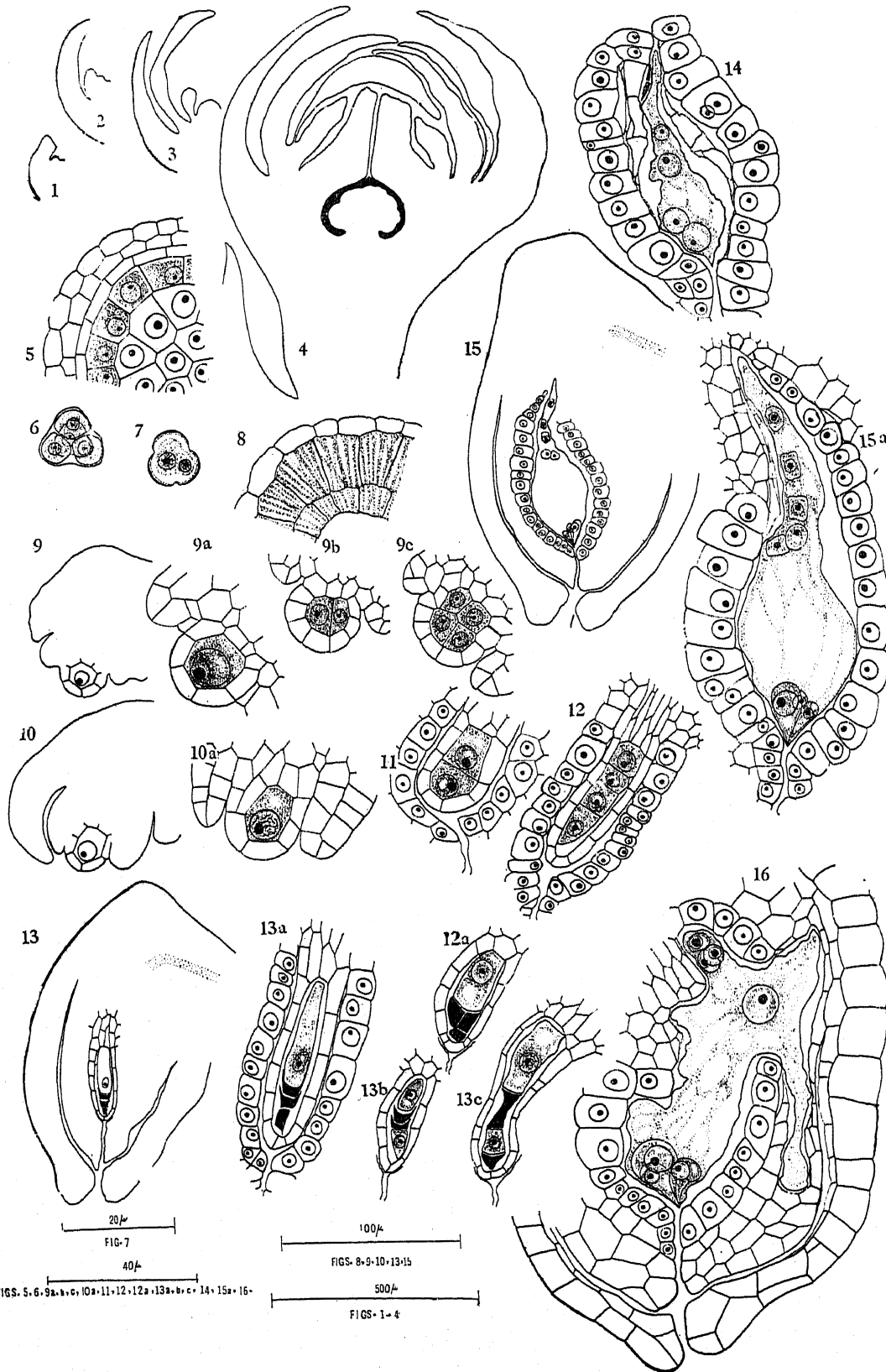
The material under investigation was collected by Fr. C. J. Saldanha, from the Ghat forests of Hassan District, Mysore State and fixed in Formalin-acetic-alcohol. Dehydration and embedding were done following the customary methods. Sections were cut at a thickness of 8–14  $\mu$  and stained in Heidenhain's iron-alum haematoxylin with eosin in clove oil as the counter-stain.

#### OBSERVATIONS

*Flower.*—The floral parts arise in acropetal succession (Figs. 1–3). Fig. 4 represents the longisection of a young flower bud showing the development of floral parts.

*Microsporangium and male gametophyte.*—The vascular bundle which traverses the filament of each stamen divides in the connective. A transection of each lobe of the young tetralocular anther shows a group of microspore mother cells surrounded by a tapetum, a middle layer, endothecium and epidermis (Fig. 5). The cells of the glandular tapetum are uninucleate throughout. As the anther matures it becomes absorbed. The endothecium and middle layer cells develop fibrillar thickenings (Fig. 8). The epidermis persists till the anther dehisces (Fig. 8). The microspore mother cells are polygonal in outline with a prominent nucleus. After undergoing the usual meiotic divisions they form tetrahedral tetrads of microspores (Fig. 6). Pollen grains are triporate and 2-celled at the time of dehiscence of the anther (Fig. 7).

Sterility during different stages of the development of the anther and male gametophyte was observed. In female flowers the androecium was reduced to staminodes. In a few bisexual flowers one or more loculi of anthers aborted, showing no signs of normal development while in some bisexual flowers all loculi of the same anther attained the same degree of development and size. In others the pollen mother cells fail to undergo meiosis and



FIGS. 1-16

degenerate gradually. In bisexual flowers, anthers fully developed were not healthy and normal. They enclosed usually small, fewer in number, shrunken nonviable pollen grains and the endothecium was poorly developed

*Ovary and megasporangium.*—The ovary is adnate to the calyx tube. A globular mound of tissue arises from the base of the ovary and forms the free central placenta. Several ovular primordia arise as erect protuberances from the placenta all around; they project into the ovarian cavity and by further growth attain an anatropous condition. The ovules are bitegmic and tenuinucellar with the micropyle formed by the slightly swollen distal ends of both the integuments.

*Megasporogenesis and female gametophyte.*—The archesporium differentiates hypodermally when the ovule primordium is still erect or nearly erect (Fig. 9). The initials are distinguishable from the neighbouring cells by their large size, dense cytoplasm and prominent nuclei (Fig. 9 *a*). The archesporial initials vary in number from one to many (Figs 9 *a*, *b*, and *c*). In all the young ovules observed only one archesporial initial directly functions as the megaspore mother cell. Just before meiosis the megaspore mother cell undergoes considerable elongation. By now, the integuments nearly cover the nucellus all around. The narrow micropyle is organised at the dyad stage (Fig. 11). The integuments are massive, the outer and inner integuments are 2 and 3-layered respectively. The tapetal activity of the cell layer of the inner integument lining most part of the nucellus initiates at this stage and becomes histologically obvious at the tetrad stage as the endothelium. The linear arrangement of megaspores in a tetrad is common (Fig. 12). However, there are instances where the second and the third degenerating megaspores appear adjacent to each other (Fig. 12 *a*). In the linear tetrad the chalazal megaspore functions while the upper three degenerate (Fig. 13 *a*). Abnormalities were also observed in the sequence of degeneration of the three upper megaspores in a linear tetrad; either the uppermost or the one below it shows belated degeneration (Figs. 13 *b* and 13 *c*).

The nucleus of the functional megaspore undergoes three successive mitotic divisions and develops into the embryo sac of the Polygonum type. The embryo sac begins to enlarge and elongates considerably. Meanwhile, the surrounding nucellar cells are crushed and the embryo sac comes to lie in direct contact with the endothelium whose cells are now enlarged with dense cytoplasm and prominent nuclei. The cells of this layer are usually uninucleate; sometimes they are binucleate here and there.

At the 4-nucleate stage, the chalazal end of the embryo sac starts growing aggressively and, elongates by crushing the neighbouring tissues thus behaving as a haustorium (Fig. 14). As the embryo sac becomes 8-nucleate the ovule becomes perfectly anatropous. At this stage the two polar nuclei lie close to the antipodal cells (Fig. 15 a). Subsequently, the embryo sac develops two lateral caeca, of which one becomes highly aggressive and grows up into the integumentary tissue (Fig. 16). The mature embryo sac consists of an egg apparatus, a large secondary nucleus and three antipodal cells. The large egg is median to the laterally placed synergids. The antipodal cells are placed in the chalazal caecum. The secondary nucleus lies midway between the chalazal caecum and the lateral caecae.

#### CONCLUSIONS

Several herbaceous Primulales have been investigated by the morphologists from the embryological point of view but relatively less attention, however, has been paid to the arborescent members of this interesting group. The present investigation reveals some differences from the account of previous reports on other genera of Myrsinaceae and Primulales in general.

Microsporangial development has been traced for the first time in this family. In general the development of the anther resembles Primulaceae closely. The main difference is, while the middle layer in Primulaceae is reported as ephemeral, it develops fibrillar thickenings. This is contradictory to the observations reported by Chatin (1870) in *Badula* (Myrsinaceae) where the endothecium is nonfibrillar. The septate nature of anthers reported by Karsten (1891) for *Aegiceras najus* is absent in this taxon. Pollen grains are 2-celled at the time of shedding as in *Ardisia solanacea* (Schurhoff, 1926). The persistence of epidermis as a distinct layer is a notable feature. Further a change from bisexual nature to unisexuality through gradual transition of pollen sterility and transformation of stamens to staminodes was observed.

The developmental features of the ovule reveal deviations from the earlier reports in the organisation of the micropyle by both the integuments and non-synchronous degeneration of megaspores. The behaviour of the embryo sac at the chalazal end into an aggressive haustorium is a very noteworthy and remarkable feature.

#### ACKNOWLEDGEMENTS

It is my pleasant duty to record my gratitude to Professor S. Shamanna for encouragement and Fr. Cecil J. Saldanha, for providing the material,

I am thankful to Fr. A. P. Menezes, Principal, St. Joseph's College, Bangalore, for encouragement and to Mr. G. Shivaramiah for help rendered during this investigation.

## REFERENCES

- Braun, A. .. "Über Polyembryonie und Keimung von *Coelobogyne*. Ein Nachtrag Zu der Abhandlung über Parthenogenesis der Pflanzen," *Abh. kon. Akad. wiss. Berlin, phys. Abt.*, 1860, 107-263.
- Carey, G. and Fraser, L. .. "The embryology and seedling development of *Aegiceras majus*," *Proc. Linn. Soc. N.S.W.*, 1932, 57, 341-60.
- Chatin, J. .. "De L'anthere," Paris, 1870.
- Dahlgren, K. V. O. .. "Zytologische und embryologische Studien über die Reihen Primulales und Plumbaginales," *Kgl. Svensk. Vet. Akad., Handl.*, 1916, 56, 1-80.
- Engler .. *Syllabus*, 1892, 6, 154.
- Hofmeister, W. .. "Embryobildung der Phanerogamen," *Jahrb. f. wiss. Bot.*, 1858 a, 1, 101-03.
- ..... .. "Neuere Beobachtungen über die Embryobildung der Phanerogamen," *Ibid.*, 1858 b, 1, 82-190.
- Hutchinson, J. .. *The Families of Flowering Plants*, Second Edition, 1959, 1, 345-46.
- Jaensch, O. .. "Beitrag zur Embryologie von *Ardisia crispa*," *Diss. Breslau*, 1905.
- Karsten, G. .. "Über die Mangrove-Vegetation im malayischen Archipel. Eine morphologische-biologische Studie," *Bibl. bot. Stuttgart*, 1891, 22, 11-18, 31-41.
- Schurhoff, P. N. .. "Zur Pleiophylie der Sympetalen auf Grund ihrer Haplontenentwicklung," *Rep. spec. nov. reg. Veget. Beih.*, 1926, 41, 3-14.
- Warming, E. .. "De l'ovule," *Ann. Sci. nat. Bot.*, 1878 (6) 5, 177-266.

## EXPLANATION OF FIGURES

FIGS. 1-16. Figs. 1-3. Development of floral parts in acropetal succession. Fig. 4. L.S. young flower bud. Fig. 5. Portion of anther lobe showing epidermis, endothecium middle layer, uninucleate tapetum and pollen mother cells. Fig. 6. Tetrahedral arrangement of microspores. Fig. 7. 2-celled pollen grain. Fig. 8. Portion of anther wall showing epidermis, fibrillar endothecium and fibrillar middle layer. Fig. 9. Young ovule and archesporial cell. Fig. 9 a. Ovule and archesporial cell. Fig. 9 b. Ovule showing 2 archesporial cells. Fig. 9 c. Ovule showing 4 archesporial cells. Fig. 10. Young ovule and

megaspore mother cell. Fig. 10 *a*. Megaspore mother cell enlarged, Fig. 11. Dyad. Fig. 12. Linear tetrad of megaspores. Fig. 12 *a*. Tetrad with second and third megaspores adjacent to each other. Fig. 13. Ovule and linear tetrad of megaspores. Fig. 13 *a*. Linear tetrad of megaspores, upper three degenerating. Fig. 13 *b*. Linear tetrad of megaspores, 2nd and 3rd degenerating. Fig. 13 *c*. Linear tetrad of megaspores, 1st and 3rd degenerating. Fig. 14. 4-nucleate embryo sac showing chalazal growth. Fig. 15. Early 8-nucleate embryo sac and chalazal haustorium. Fig. 15 *a*. Organised embryo sac with chalazal haustorium. Fig. 16. Portion of ovule showing mature embryo sac with lateral haustorial extensions.