A CONTRIBUTION TO THE EMBRYOLOGY OF
ALANGIUM LAMARCKII THW. WITH A DISCUSSION
OF THE SYSTEMATIC POSITION OF THE FAMILY
ALANGIACEÆ

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Received August 3, 1945
(Communicated by Prof. L. S. S. Kumar, F.A.Sc.)

The order Umbellifloræ comprises three families, Umbelliferaæ, Araliaceæ and Cornaceæ. The only previous work on the genus Alangium belonging to Cornaceæ is that of Schnarf (1922) who investigated the structure of the flower and ovule in Alangium Handelli. A. Lamarckii Thw. is common at Bangalore and in other parts of India. The whitish flowers, which appear during the months of February and March, are found in axillary fascicles or condensed cymes and are hermaphrodite, joined on the pedicel. Bracts are absent, the calyx tube is adnate to the ovary and there are 5-10 linear oblong petals with a valvate aestivation. The stamens are usually as many as the petals or more with hairy filaments and long anthers. The ovary is inferior and surmounted by a disc. The style is long and the stigma large and capitate. The flowers emit a peculiarly characteristic odour.

The material for microsporogenesis was fixed in Navaschin’s fluid after a 10 to 15 minutes immersion in Carnoy’s fluid. Some smear preparations were also made and stained in gentian violet. The material for megasporogenesis was fixed in Allen’s modification of Bouin’s fluid and in formalin-acetic-alcohol. The sections which were cut 6 to 18µ thickness were stained in Heidenhain’s iron-hæmatoxylin with a counterstain of cosin in clove oil.

There are 20-30 stamens. A cross-section of the anther shows the usual tetra-sporangiate condition (Fig. 3). The parietal tissue consists of an epidermis, the endothecium, a single middle layer and the tapetum (Fig. 2). The tapetal cells are conspicuous owing to their prominent nuclei and soon become binucleate conforming to type II of Cooper (1933). Degeneration of the tapetum takes place as soon as the microspores begin to separate from each other.

A single row of sporogenous cells is differentiated in each lobe (Fig. 1). These are characterized by having dense cytoplasm and conspicuous nuclei.
Figs. 1–11.—Fig. 1. Longitudinal section of the anther showing the layer of sporogenous cells in one of the lobes. ×704. Fig. 2. T.S. part of anther showing the epidermis, endothecium, middle layer and binucleate tapetum. ×1900. Fig. 3. Diagram of cross-section of anther. ×400. Fig. 4. Same in diakinesis. ×1900. Figs. 5 and 6. Microspore mother-cell in reduction division showing eight chromosomes. Fig. 7. Tetrad of microspores. ×900. Fig. 8. A portion of the ovary wall enlarged to show the development of hairs. ×480. Fig. 9. Cross-section through the ovule to show the distribution of the vascular strands. ×480. Fig. 10. Cross-section of the ovary showing the distribution of vascular strands in the ovary and the ovule. OV, ovule; ES, embryo-sac. Fig. 11. Ovule showing sporogenous cell and single integument. ×704.
They undergo the usual reduction divisions to form tetrads of microspores. Polar views of the meiotic metaphase plates show the haploid number of chromosomes to be eight (Figs. 4, 5, 6). This has also been confirmed by counts in root tips where the diploid number was determined to be sixteen. The pollen at the shedding stage shows only one nucleus.

The ovary is inferior and unilocular (Fig. 10). In A. Handelli, Schnarf (1922) reports a bilocular ovary with one ovule in each locule, although only one of the two develops to maturity. The wall of the ovary is densely tomentose and this renders sectioning very difficult. The hairs originate from the epidermis and are uninucleate (Fig. 8). There is a single pendulous anatropous ovule as is characteristic of the Umbelliferae.

There is a single massive integument which originates from the base of the nucellus but grows enormously (Fig. 11) so that the micropyle is long and narrow. The inner epidermis of the integument develops into an epithelial layer (Fig. 18) which has also been reported in A. Handelli (Schnarf, 1922), Benthamia (Horne, 1914), Cornus suecica (Morse, 1909) and Aralia racemosa (Ducamp, 1902). The nucellar cells disorganise on all sides of the embryo-sac except at the micropyle and chalaza (Figs. 17 and 18). At the chalazal end there is a persistent hypostase tissue composed of 4-5 layers of richly cytoplasmic cells. As in A. Handelli (Schnarf, 1922) there is a well-developed conducting strand consisting of elongated cells which are connected with the hypostase and continue further upwards upto the micropylar region of the integument (Figs. 9 and 12).

There is a single hypodermal archesporial cell which divides into a primary parietal cell and a megaspore mother cell (Figs. 11, 13). The latter undergoes the usual reduction divisions and forms a linear tetrad of megaspores of which the chalazal alone functions and the upper three degenerate (Fig. 14). The development of the embryo-sac is of the monosporic eight-nucleate type. The egg is fairly large in size and the polar nuclei meet very early but remain unfused till the time of fertilization. However this is not a constant feature and certain exceptional cases are noted where the polars fuse early. The antipodals are uninucleate in most cases and degenerate just prior to fertilization, but in some cases (Fig. 16) they show further development leading to the formation of antipodal embryos (Gopinath, 1943). It is a case of haploid apogamy. The entry of the pollen tube is of the usual porogamous type and in this process the small group of nucellar cells occurring on the top of the embryo-sac is also partially crushed and disorganised (Fig. 17). The endosperm is free nuclear in the initial stages (Fig. 18) but later becomes cellular, storing in its cells large quantities of
Fig. 12–18.—Fig. 12. Longitudinal section through the ovule showing the course of the vascular supply in the integument. \( \times 480 \). Fig. 13. Nucellus showing megaspore mother-cell. \( \times 704 \). Fig. 14. Two-nucleate embryo-sac with remains of the upper three megaspores. \( \times 1520 \). Fig. 15. Embryo with short suspensor embedded in a mass of endosperm cell. \( \times 480 \). Fig. 16. Mature embryo-sac. Note the increased number of cells at the antipodal end. \( \times 1140 \). Fig. 17. Fertilisation. \( \times 475 \). Fig. 18. First division of the fertilized egg and free nuclear divisions of the endosperm. Note also the integumentary tapetum. \( \times 440 \).

reserve food materials. The embryo has a short suspensor consisting of four to five cells (Fig. 15).


**DISCUSSION**

The systematic position of the genus *Alangium* is of much interest. Bentham and Hooker (1879) place it under the Cornaceae along with *Cornus*, *Acuba*, *Benthamia* and others. Engler and Prantl (1931) on the other hand have allocated a separate family Alangiaceae with one genus *Alangium* and included it under the Myrtilloae. Hutchinson (1926) while recognising the Alangiaceae as an independent family, places it under the order Umbelliflorae. The latter view is also supported by Schnarf (1922).

The first point to be considered in this connection is the presence of a single integument which is common to both the Cornaceae and *Alangium* (Brown and Horne, 1914). Wangerin (1910) however incorrectly ascribed two integuments to the ovule of *Alangium* (on the basis of Baillon's work) and removed it from the Cornaceae to the Myrtilloae, placing it between the Rhizophoraceae and Combretaceae. In the present study the author had an opportunity of making comparative studies of *Alangium* with some members of the Umbelliflorae including the Araliaceae (Gopinath, 1944). It strongly confirms Schnarf's view that the Alangiaceae should be treated as a separate family but included under the order Umbelliflorae. The Umbelliflorae, Cornaceae and Araliaceae have an inferior ovary, with a single pendulous anatropous ovule provided with a single integument. A similar condition occurs in *Alangium*. Again in many members of the Umbelliflorae also, including *Sium* (Coulter and Chamberlain, 1903) the nucellar cells are ephemeral and the integument forms an epithelial layer lining the embryo-sac. Some Araliaceae investigated by the writer are also similar.

The chalazal strand observed in *A. Lamarckii* is also known in other families belonging to the Myrtilloae, viz., Lythraceae (Joshi and Venkateswarlu, 1935–36), Thymeleaceae (Kausik, 1940), Sonneratiaceae (Venkateswarlu, 1937), but it seems to be related with the nutrition of the embryo-sac and might not have much systematic value and in any case the inferior ovary of *Alangium* with a single pendulous ovule and only one integument definitely speak against its relationship with the Myrtilloae. Coming now to the position of the genus *Alangium* in the Umbelliflorae it has already been pointed out that Bentham and Hooker include it under the Cornaceae without erecting a separate family for the purpose. The embryological evidence does not support such a view however. Thus, the multiple archesporium observed in *Acuba japonica* (Horne, 1941), *Benthamia capitata* (Jonsson, 1881), and *Cornus mas*, *C. sinesis*, *C. florida* (Hakansson, 1923) is conspicuously absent in both the species of *Alangium* so far investigated. Further, in *A. Lamarckii* the antipodals sometimes persist till the time of fertilization
and occasionally divide further to form antipodal embryos, while in the Cornaceae an early degeneration of the antipodals is universal. In the various members of the Cornaceae so far investigated the heterotypic division in the megaspore mother cell is not accompanied by wall formation, with the result that four free nuclei are present of which one is functional (Schnarf, 1931; Morse, 1907). In Alangium on the other hand, a clear linear row of megaspores is formed. Again the type of endosperm formation, which is nuclear in Alangium and cellular in Cornaceae, emphasizes the difference between the two. All these facts together with the upward extension of the vascular tissue into the integument which is found in A. Lamarckii and A. Handelli, but not known in any of the Cornaceae clearly confirm Schnarf's opinion that the Alangiaceae should be placed as an independent family under the Umbelliflorae.

**Summary**

The embryology of Alangium Lamarckii Thw. has been studied. A cross-section of the anther shows an epidermis, the endothecium, a single middle layer and the tapetum. The haploid number of chromosomes is eight. There is a single anatropous ovule with one integument. The development of the embryo-sac conforms to the Normal type and an epithelial layer is formed from the inner epidermis of the integument. Fertilization is porogamous and the endosperm nuclear. It is concluded that the genus Alangium should be placed in a separate family, the Alangiaceae, under the order Umbelliflorae.

**Acknowledgments**

In conclusion, the author wishes to acknowledge with thanks the facilities and encouragement given by Dr. L. S. Dorasami, Economic Botanist, Department of Agriculture, Bangalore. He is also grateful to Dr. P. Maheshwari of the Dacca University for going through the manuscript and giving valuable suggestions and to Dr. M. J. Thirumalachar for kind help at various stages of the work.

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* Original not seen.