A CONTRIBUTION TO THE EMBRYOLOGY OF *OLDENLANDIA UMBELLATA* LINN.

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ABSTRACT

The embryology of *Oldenlandia umbellata* Linn. has been investigated. Floral parts arise in acropetalous succession. A transection of an young anther shows a group of microscope mother cells followed by a layer of tapetum, a middle layer, an endothecium and an epidermis. The uni-nucleate tapetum is of the glandular type. Microspore tetrads are tetrahedral and isobilateral. The pollen grain is binucleate at the time of anther dehiscence and the endothecium fibrillar. A hypodermal archesporial cell directly functions as the megaspore mother cell. Embryo sac development follows the Polygonum type. Fertilisation is porogamous. Endosperm is free nuclear and embryogeny conforms to the solanad type.

INTRODUCTION

FOLLOWING the classical researches of Lloyd (1902) the embryology of several genera of Rubiaceae has been studied by a number of workers, the most notable among them being Fagerlind (1937). He has not only revised some of the erroneous views of Lloyd (1902) but also has delt in detail the embryology of several genera of Rubiaceae. Houk (1938) has studied the development of integument and nucellus in *Coffea.* His view that there is no distinction between the tissues of the integument and nucellus is open to question and Mendes (1941) has explained this aspect. Raghavan and Rangaswamy (1941) have worked on the embryology of *Dentilla repens* and *Oldenlandia alata*, and Raghavan and Srinivasan (1941) on the development of microsporangium, embryo sac and embryo in *Spermacoce hispida* and *Guttardia speciosa.*

The recent studies on the embryology of this family include those of Raman (1954) on *Stiphegyne parviflora*, Venkateswarulu and Rajeswara Rao

(1958) on *Rubia cordifolia* and *Hamelia patens*, Farooq (1952, 1953, 1960) on *Boreria oldenlandia* and *Galium*, Ganapathy (1956 *a, b*) on *Hydrophylax maritania* and *Ophiorrhiza mungos*, Gopinath and Channaveeriah (1961) on *Ophiorrhiza harrison*, Shivaramaiah and Ganapathy (1961) on *Knoxia corymbosa*, Shivaramaiah and Dutt (1965) on *Rondoletia amoena* and Periaswamy and Parameswaran (1965) on *Torenna asiatica*. The present paper deals with the embryology of *Oldenlandia umbellata* Linn.

MATERIALS AND METHODS

The material was collected round about Bangalore and fixed in F.A.A. Customary methods of dehydration and paraffin embedding were followed. Sections were cut between 6 to 10 microns and were stained in Heidenhain's iron Haematoxylin.

FLOWER AND ORGANOGENY

The flowers are bisexual, complete, regular and gamopetalous. The calyx consists of four short lobes which are persistent. The corolla is short and tubular with four lobes. The stamens are four in number and are inserted on the throat of the corolla. The ovary is inferior bicarpellary and bilocular with number of hemianatropus ovules on axile placenta.

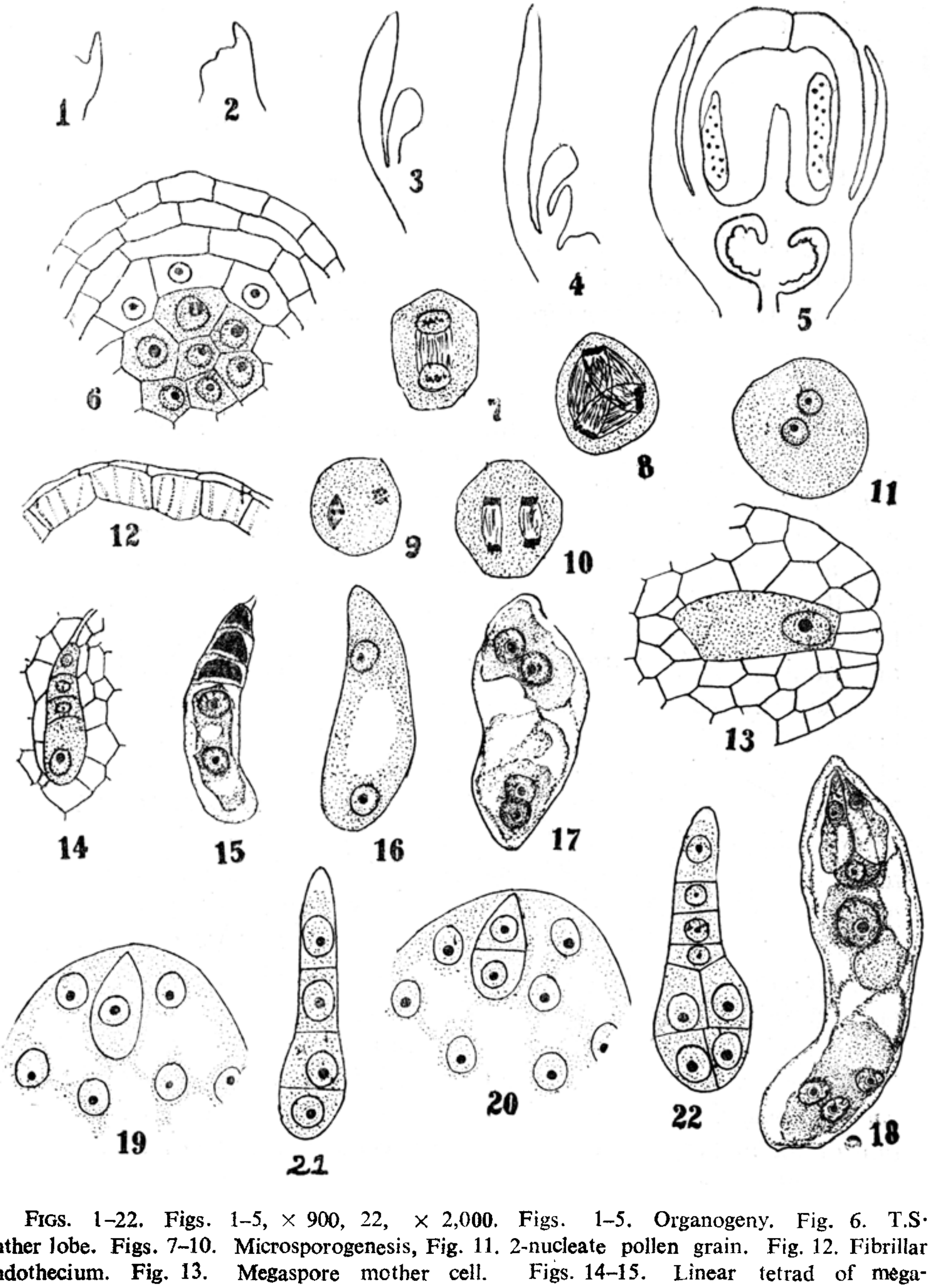
The floral parts arise in acropetalous succession (Figs. 1-5).

MICROSPORANGIUM AND MALE GAMETOPHYTE

A transverse section of an young anther lobe shows a group of microspore mother cells followed by a layer of tapetum a middle layer, an endothecium and an epidermis (Fig. 6). The uninucleate tapetal cells are of the glandular type. Microspore mother cells undergo reduction division to form tetrahedral and isobilateral tetrads of microspores (Figs. 7–10). The pollen grain is binucleate at the time of shedding (Fig. 11). The endothecium exhibits fibrillar thickenings at the time of anther dehiscence (Fig. 12).

MEGASPORANGIUM AND FEMALE GAMETOPHYTE

The hemianatropus ovules in the ovary are tenuinucellar and unitegminal. A hypodermal archesporial cell in the nucellus directly functions as the megaspore mother cell (Fig. 13). It undergoes meiosis to give rise to a linear tetrad of megaspores. In this the micropylar three megaspores degenerate and the chalazal alone is functional (Figs. 14–15). The nucleus of the functional megaspore undergoes three successive mitotic divisions to



FIGS. 1–22. Figs. 1–5, × 900, 22, × 2,000. Figs. 1–5. Organogeny. Fig. 6. T.S. anther lobe. Figs. 7–10. Microsporogenesis, Fig. 11. 2-nucleate pollen grain. Fig. 12. Fibrillar endothecium. Fig. 13. Megaspore mother cell. Figs. 14–15. Linear tetrad of megaspores. Figs. 16–18. Development of embryo sac. Figs. 19–22. Development of embryo.

give rise to an eight-nucleate embryo sac of the Polygonum type (Figs. 16-18). The egg apparatus consists of a median egg and two synergids. The secondary nucleus is close to the egg. The three antipodals remain as nuclei (Fig. 18).

FERTILISATION, ENDOSPERM AND EMBRYO

Fertilisation is porogamous. The endosperm is *ab initio* nuclear. The primary endosperm nucleus divides earlier than the zygote and produces two free nuclei. These by further divisions give rise to a number of nuclei, which become cellular later. The endosperm is absorbed by the developing embryo. Embryogeny conforms to the Solanad type (Figs. 19-22)

DISCUSSION

According to Schumann, the sub-family Cinchonoideae of Rubiaceae is characterised by Polyspermous fruit characters. The reduction in the number of ovules in Cinchonoideae has been regarded as a step towards progressive evolution (Fagerlind, 1937). Among Cinchonoideae some have only a few ovules. Out of six species of *Cephalanthus* one has three ovules and the others only one ovule in each loculus. In *Tricalysia* there are two to eight ovules. These cases have been regarded as transitional stages towards the condition met within the Coffeaoideae by Fagerlind. It is interesting to note that the genus *Oldenlandia* possesses several ovules. Yet on the basis of the embryological characters it has been considered as one of the highly evolved genera of the sub-family Cinchonoideae (Fagerlind, 1937). Lloyd (1902), Fagerlind (1937) considered *Haustonia* is highly evolved among Cinchonoideae. According to Lloyd increase in the number of ovules has resulted in the reduction of archesporial tissue and the production of an undifferentiated ovule. This statement of Lloyd cannot be generalised as the scheme of development of ovule and the number of ovules both in *Haustonia* and *Oldenlandia umbellata* is the same. But the archesporium in the latter is one-to two-celled and the nucellus is also represented by one to two epidermal cells. Probable lines of reduction of the archesporium and the nucellus in Rubiaceae has been shown by Fagerlind (1937). According to him *Oldenlandia* is placed second to *Haustonia* in these respects. However, the condition of the archesporial tissue and the nucellus in *O. umbellata* is similar to *O. corymbosa* (Farooq, 1958).

Megaspore tetrads show great uniformity in their arrangement. They are always linear. The development and organisation of embryo sac is monosporic, 8-nucleate as in other plants of this family. Tetrasporic embryo sacs have been recorded only in *Crunecilla* and *Rubia olivieri* (Lloyd, 1902;

Fagerlind, 1937). The antipodals are ephemeral and disorganise after fertilisation, but in other genera such as *Vailantia*, *Rubia*, *Galium* and *Asperula*, they are well developed and persistent. This latter type of antipodals are important for the transport of nutritive materials.

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