AN EMBRYOLOGICAL STUDY OF MIMOSA PUDICA LINN.

BY S. G. NARASIMHCHAR, M.Sc.
(Section of Economic Botany, Department of Agriculture, Bangalore)

Received November 1, 1949
(Communicated by Dr. L. S. Dorasami, F.A.S.C.)

In a previous paper by the writer (Narasimhchar, 1948) an embryological study of Acacia farnesiana was given. The material selected for the present investigation is Mimosa pudica, Linn. another member of Mimosaceae. This hardy perennial plant seems to have been introduced from America and has spread now as a weed throughout the Mysore State in both waste, as well as cultivated lands. Having a well-developed root system, it is extremely drought-resistant and perennates during the summer. The plant is gregarious in habit and has a wide dispersal mechanism. It is not easy to eradicate this pest once it has established a foot-hold in the soil. The best method of eradication seems to be to dig out the entire plant with the roots before it sets seeds. Specially during the rainy season the plants may be easily spotted out by their pink flowers contrasting against a back ground of rich green foliage.

Buds, flowers, and fruits were fixed in Formalin-acetic-alcohol and Allen's modified Bouin's fluid. Sections were cut from 6μ to 10μ and stained in Heidenhain's Iron-alum Haemotoxylin.

MICROSPORANGIUM

The wall of the young anther shows three layers beneath the epidermis - the endothecium, a middle layer, and the innermost layer or the tapetum (Fig. 1). The endothecium develops fibrillar thickenings when the anther is mature, and the middle layer is crushed. The tapetal cells remain uninucleate throughout (Fig. 2). In the early stages during the course of development, sterility of sporogenous tissue is invariably seen due to failure of meiotic stages (Fig. 3). The microspore mother-cells undergo the usual reduction divisions and form microspore quartets which show either a bilateral or tetrahedral arrangement (Figs. 4 to 8). The individual microspores of the quartet do not separate but remain as a unit and are shed in the same condition as seen in the compound grains of Acacia Baileyana (Newman, 1934), Acacia farnesiana (Narasimhchar, 1948) and Drosera Burmanni (Narasimhchar, 1949). Each mature pollen grain contains a generative and a tube nucleus (Fig. 9). Germination of pollen grains in
situ was found in many anther locules (Fig. 2) suggesting a tendency towards cleistogamy.

During the study of meiosis in the microspore mother cells, 24 bivalents were counted (Fig. 4) in the first metaphase plate which confirms the 2x number 48 reported by Kawakami (1930).

MEGASPOROGENESIS AND THE DEVELOPMENT OF THE EMBRYOSAC

The superior unilocular ovary develops three to five ovules on the marginal placenta. The ovule is at first erect but later on becomes anatropous due to subsequent growth. The archesporium consists of three to four cells (Fig. 10) hypodermal in origin. Only a single cell develops further (Fig. 11) and cuts off parietal cells, so that the megaspore mother-cell is situated about 3-4 cell layers below the epidermis. A multiple epidermis is later on developed as in Acacia Baileyana (Newman, 1934).

The megaspore mother-cell crushes the surrounding nucellar cells as it enlarges in size and after undergoing two successive divisions gives rise to the linear tetrad (Fig. 11) of megaspores. The chalazal megaspore enlarges in size and forms the typical monosporic eight nucleate embryosac, while the upper three megaspores degenerate.

The mature embryosac is broad at the micropylar end and tapers towards the chalazal end (Fig. 15). All the parietal tissue later on gets obliterated by the developing embryosac so that it lies next to the multiple epidermis. The cells of the multiple epidermis break down as the embryosac enlarges in size contributing to the nutrition of the embryosac. The antipodals are organized as definite cells and show signs of degeneration when the embryosac is fully organized, and the degenerating antipodals may persist until fertilization (Figs. 15 to 18). The synergids are pyriform and slightly beaked with the filiform apparatus (Fig. 16). A vacuole is situated beneath the nucleus in each synergid. The position of the egg is variable. It may be situated at one side of the synergid or between the synergids. The two polys may remain in contact with each other or may fuse to form a big fusion nucleus when the embryosac is ready for fertilization (Figs. 15 and 16), and is found to lie immediately beneath the egg, or in the middle of the embryosac. Starch grains are found in the embryosac from the eight-nucleate stage onwards and persist as in Acacia Baileyana (Newman, 1934), and Acacia farnesiana (Narasimhachar, 1948).

Occasionally two embryosacs have been met with probably due to two megaspore mother-cells developing simultaneously. This is considered to be an abnormality, as these embryosacs are found to degenerate later (Fig. 23).
An Embryological Study of Mimosa pudica Linn.

Figs. 1-24. Fig. 1. Portion of a transverse section of young anther showing epidermis, wall layers, tapetum and microspore mother-cells, × 480. Fig. 2. Portion of the mature anther showing the prominent fibrillar endothecium and uni-nucleate tapetum. Some of the microspore quartets are germinating in situ, × 800. Fig. 3. Portion of a transverse section of young anther showing degenerating sporogenous tissue and normal sporogenous cells, × 400. Fig. 4. Metaphase plate showing 24 bivalents, × 3,600. Figs. 5 & 6. Spindle arrangement to form isobilateral or tetrahedral microspore quartets, × 3,600. Figs. 7 & 8. Stages in the formation of microspore tetrads, × 3,600. Fig. 9. A quartet of pollen grains at the shedding stage, each showing a generative and a tube nucleus, × 3,600. Fig. 10. Multiple archesporium, × 1,800. Fig. 11. Megaspore mother-cell and the parietal cell dividing, × 1,800. Fig. 12. Telophase in the megaspore mother-cell to form the diad, × 1,800. Fig. 13. Linear tetrad showing the enlarging chalazal megaspore and the degenerating upper three megaspores, the parietal layer and the integuments, × 1,800. Fig. 14. Division of the nuclei in the two nucletate embryosac to form the four-nucleate embryosac, × 1,800. Fig. 15. Fully organized embryosac showing the egg-apparatus, Secondary nucleus, degenerating antipodals and starch grains, × 1,800. Fig. 16. Longitudinal section of an ovule showing the fully organized embryosac with the egg apparatus, poles, degenerating antipodals and starch grains with the fully formed integuments, × 1,800. Figs. 17 & 18. Stages in double fertilization with the male nuclei in contact with the egg and the Secondary nucleus respectively, × 1,800. Fig. 19. Egg-apparatus with synergids × 1,800. Fig. 20. Fertilized egg with two endosperm nuclei, × 1,800. Figs. 21 & 22. An advanced embryo with cellular endosperm around the egg and lower portion showing nuclear endosperm, × 1,800. Fig. 23. Abnormal ovule with two embryosacs, × 1,800. Fig. 24. Longitudinal section of an ovule showing ill-formed outer integument and degenerating zygote, × 480.

The integuments are rather belated in appearance. The inner integument appears first and later the outer integument. By the time the mature embryosac is organised, the inner integument covers the nucellus completely excepting the micropyle, while the outer integument overgrows the inner one (Fig. 16). The inner integument is only two cells thick except at the micropyle while the outer one is three to four cells in thickness, with a single vascular strand entering from the funiculus (Fig. 41). It becomes more massive after fertilization crushing the cells of the inner integument at the sides of the embryosac except at the micropyle (Figs. 42 and 43). Occasionally in degenerating embryosacs the outer integument may develop only halfway while the inner integument overgrows it (Fig. 24).

During fertilization, one of the synergids is destroyed by the entry of the pollen tube while the other one persists for a long time. Both syngamy and triple fusion occur as a normal process during fertilization (Figs. 17 and 18).

**ENDOSPERM**

The primary endosperm nucleus divides much earlier than the fertilized egg in a free nuclear manner (Fig. 20). By this time, the embryosac has increased in size. This is accompanied by the increase in number of endosperm nuclei which take up a peripheral position lining the embryosac. Some nuclei cluster round the developing zygote and others at the chalazal end.
Figs. 25–44. Figs. 25–30. Stages in embryogeny. (Figs. 25–27 × 1,800) (Figs. 28–30 different ways of forming the five-celled embryo, × 1,800). Fig. 40. Longitudinal section of an ovule showing the zygote in Telophase, four hypertrophied endosperm nuclei and two
abnormal endosperm nuclei. Starch grains still persisting, × 1,800. Fig. 41. Longitudinal section of ovule showing the disposition of the vascular strand, × 800. Fig. 42. Longitudinal section of an advanced ovule showing the massive outer integument and the crushed cells of the inner integument below the micropylar region, × 800. Fig. 43. Longitudinal section of an advanced ovule showing the chalazal hypostase like tissue, free endosperm nuclei in contact with disorganizing multiple epidermis and the chalazal region with the ingrowing embryosac containing free endosperm nuclei, × 800. Fig. 44. A longitudinal section of a mature seed showing the dicotyledonous embryo, with the spurred cotyledons, stem and root tip, × 100.

Cell formation is restricted to the upper two-thirds of the embryosac while the lower end consists of free endosperm nuclei (Figs. 21 and 22) as in Acacia Baileyana (Newman, 1934) and Acacia farnesiana (Narasimhachar, 1948). At the micropylar end of the embryosac most of the parietal tissue and multiple epidermis are destroyed (Fig. 42) while at the lower end, the embryosac with the free endosperm nuclei shows a tendency to grow into the chalazal region consisting of cells rich in contents (Fig. 43) simulating the basal apparatus of Hypericum (Swamy, 1946) but without developing into any special organ of the endosperm. In addition, some layers of the multiple epidermis bordering the sides of the embryosac break down. Thus the endosperm tissue and the basal apparatus with free endosperm nuclei seem to take part in providing nutrition to the growing embryo.

Instances are occasionally met with in degenerating embryosacs, hypertrophied and normal endosperm nuclei, as in Fig. 40 where the fertilized egg is in telophase with four hypertrophied and two normal endosperm nuclei.

**EMBRYO**

The first division of the zygote does not take place until sixteen endosperm nuclei are formed, while in *Acacia Baileyana* (Newman, 1936) and Albizzia Lebeck (Maheshwari, 1931) the zygote does not divide until eight endosperm nuclei are formed, in *Acacia farnesiana* (Narasimhachar, 1948) the zygote divides at the thirty-two nucleate stage of the endosperm. The first division of the fertilized egg is transverse (Fig. 25) dividing it into an upper and a lower cell. The second division takes place in the lower cell (Fig. 26) much earlier than the upper cell so that the embryo consists of four cells. From the four-celled stage onwards the divisions are irregular (Figs. 25 to 37) as any cell in the four-celled embryo may divide to give rise to the five-celled stage of the embryo (Figs. 28 to 30). Soon the embryo assumes a pear-shaped form. There is no differentiation into a suspensor and the embryo is of the massive type as in *Acasia Baileyana* (Newman, 1936) and *Acacia farnesiana* (Narasimhachar). In the mature seed the embryo uses up all the endosperm. The cotyledons are prominently spurred with vasculature on the adaxial face (Fig. 44). The radicle is very broad and blunt.
1. The pollen grains are shed united together in quartets. Each pollen grain contains a generative and a tube nucleus. The tapetum remains uni-nucleate throughout. During the first metaphase, 24 bivalents have been counted.

2. The archesporium consists of three to four cells though only a single cell develops further. A parietal tissue of 4–5 cells in thickness is formed.

3. Megasporogenesis proceeds normally and the embryo sac conforms to the monosporic eight-nucleate type. Synergids show the characteristic filiform apparatus and the polars may fuse before or during fertilization. Antipodals are formed as definite cells, and the degenerated remains may persist until fertilization.

4. Endosperm is free nuclear in the beginning and wall formation commences from the micropylar end stopping short of the lower one-third of the embryosac. The chalazal end contains free endosperm nuclei which aggregate simulating the basal apparatus with a tendency to grow into the chalazal region.

5. The first division of the fertilized egg is transverse while the second division which is vertical is belated in the upper cell. Later divisions are irregular and the embryo has no differentiated suspensor, being of the massive type.

In conclusion, grateful acknowledgements are made to Dr. L. S. Dorasami, M.Sc., Ph.D. (Lond.), Economic Botanist, for kind encouragement during the course of the work.

**LITERATURE**


