EMBRYO SAC

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Paper-I

Structure of a typical Embryo sac or Female gametophyte

- Megaspore (n) is the first cell of the **female gametophyte** . The functional megaspore becomes enlarged and thus forms the female gametophyte i.e., the embryo sac.
- Initially, the embryo sac is uninucleate and with further growth its nucleus divides by three successive divisions and forms eight nuclei .
- Out of eight nuclei, initially four remain towards the micropyle end and the other four towards the chalazal end.
- One nucleus from each pole then moves towards the centre and forms a pair of polar nuclei .
- These nuclei fuse together and form 2n nucleus, the definitive nucleus. It is also known as polar fusion nucleus or **secondary nucleus**.

- The three nuclei of the micropylar end form the **egg apparatus** and the rest three at the chalazal end are called **antipodal cells.**
- In the egg apparatus, each nucleus is surrounded by viscous mass of cytoplasm without any wall, of which the middle one is the largest and called egg, ovum or oosphere and the rest two (one on each side of the egg) are the synergids or helping cells.
- The antipodal cells have viscous mass of cytoplasm, covered by cellulosic wall **.**
- This type of embryo sac development is very common in angiosperms and is known as ordinary type or **normal type** or **Polygonum type.**
- This type is also known as monosporic type, because, out of four megaspores, only one remains functional and forms the embryo sac.

Types of embryo sac development :

Depending on the number of megaspore nuclei taking part in the development of female gametophyte, the latter has been classified into three major types:-

(A)Monosporic type:

Only one of the four megaspores participates in the development of embryo sac. Sub divided into two types :

1. **Polygonum type :**
   - This type of embryo sac is derived from the chalazal megaspore and is most common**.**
   - Described above as normal type

2. Oenothera type:

- In this type (like Polygonum type), usual linear tetrad of megaspores are formed, but instead of the innermost one, the outermost megaspore (which is present towards micropyle) remains functional and forms the embryo sac.
- The functional megaspore undergoes two successive divisions and forms 4 nuclei.
- All the nuclei remain towards the micropyle.
- Out of four nuclei, three nuclei form the egg apparatus (egg and two synergids) and the remaining one forms a single polar nucleus.
- Second polar nucleus and antipodal cells are absent, e.g., *Oenothera* and other members of Onagraceae.

(B)Bisporic type:

Two megaspore nuclei take part in the development of the embryo sac. Sub sdivided into two types :

1. Allium type:

- The megaspore mother cell divides to form two cells, the upper one quickly degenerates.
- The lower one then divides and forms two nuclei, distributed in the two poles.
- Later on, both the nuclei undergo two successive divisions and form usual octant type of embryo sac, i.e., polygonum type.
- Here two megaspore nuclei take part in the development of embryo sac , e.g., *Allium, Scilla, Trillium* etc., of Liliaceae.

2.**Endymion type :**

- Similar to Allium type with only one difference that the embryo sac develops from the micropylar dyad cell

(C)Tetrasporic type:

All the four megaspore nuclei take part in the development of the embryo sac. Sub divided into seven types :

1. Peperomia type:

- The megaspore mother nucleus undergoes meiotic division and forms four nuclei which remain crosswise in the embryo sac without any wall.
- All the nuclei undergo two successive divisions and form **16 nuclei** which remain dispersed inside the sac.
- Later on, out of 16 nuclei, egg and one synergid remain at the micropylar end, six antipodal cells towards the chalazal end, and the rest eight at the centre forming polar nuclei, e.g., Peperomia of Piperaceae etc.

2. Penaea type:

- Like Peperomia type**, 16 nuclei** are formed , those remain crosswise in the embryo sac.
- Later on, the nuclei are distributed in a different manner. The egg and two synergids remain at the micropylar end, three nuclei at the chalazal end, and four at the centre and three each on the two side walls, e.g., Penaea

3. Drusa type:

- Like Peperomia type, initially four megaspores are formed, these are distributed in different ways.
- One megaspore remains towards the micropyle , and the rest three at the chalazal end.
- All the nuclei undergo two divisions and form **16 nuclei**, out of which four nuclei remain towards the micropyle and the rest twelve at the chalazal end.
- In the mature embryo sac, egg and two synergids remain towards the micropyle, two (one from each pole) at the centre and the rest eleven at the chalazal end, e.g., *Drusa*

4. Fritillaria type:

- Like Drusa type, out of four nuclei formed, one nucleus remains towards the micropyle, and the rest three at the chalazal end.
- The chalazal nuclei fused together and form 3n nucleus.
- Both the cells thus undergo one mitotic division and again form a tetrasporic stage. Out of four nuclei, two remain at each pole.
- All the nuclei then undergo mitotic division and form **eight nuclei.**
- Out of four haploid nuclei at the micropyle, one egg and two synergids are formed, those remain at the micropylar end;
- three triploid nuclei at the chalazal end and one from each pole remain at the centre (one haploid and the other one triploid), e.g., Fritillaria, Tulipa and some other members of Lliliaceae

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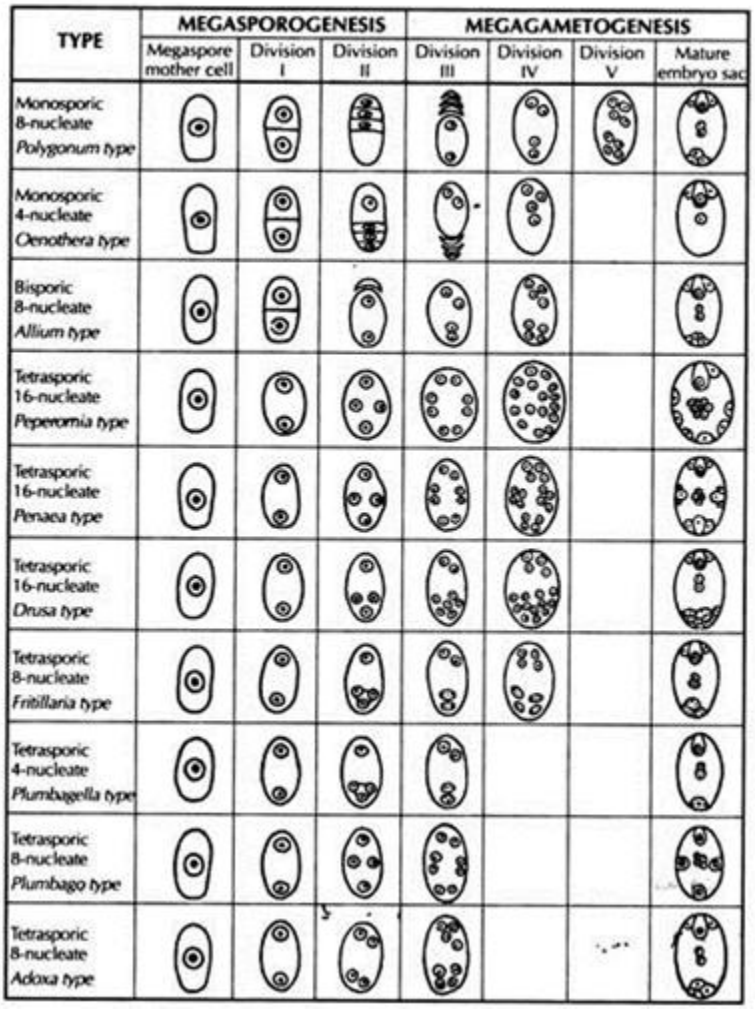

Fig.Development of different types of embryo sac in angiosperm

5. Plumbagella type:

- It is like Fritillaria type which forms 1st and 2nd tetrasporic stage with two haploid nuclei at the micropyle and two triploid nuclei at the chalazal end of the embryo sac.
- Later on, the nuclei are distributed in such a way that the egg is at the micropyle, one triploid nucleus at the chalazal end and one triploid plus one haploid nuclei at the centre, e.g., *Plumbagella*

6. Plumbago type:

- It is like Penaea type where firstly four nuclei are formed followed by eight nucleated embryo sac.

- The two nuclei at each side (four sides) remain crosswise.
- Later on, four nuclei, one from each side, become aggregated in the centre.
- The nucleus at the micropylar end behaves as egg, e.g., *Plumbago*

7. Adoxa type:

- In this type, the megaspore mother nucleus divides meiotically into four nuclei arranged two at each end.
- Both the nuclei — further undergo mitotic division and thus eight nuclei are formed.
- Like the normal type i.e., Polygonum type, one egg and two synergids remain at the micropylar region, three antipodal cells at the chalazal end and two nuclei remain in the centre, e.g., *Adoxa*

Important question:

1.Describe the development of various types of embryo sacs in angiosperms.

Or Describe the female gametophyte angiosperms.