

4. HETEROSPORY AND SEED HABIT

4-1 INTRODUCTION

Heterospory refers to the production of two kinds of spores in the same plant. The two kinds of spores differ in structure as well as in function. The smaller spores are called **microspores** and they are produced in large number in **microsporangia**; while the bigger spores are called **macrospores** or **megaspores** and they are produced in small number ranging from a few to one in the **megasporangium**. The spores show differentiation in function. **Microspore** develops into the **male gametophyte**, whereas the megaspore develops into the **female gametophyte**. Thus heterospory is associated with sexual differentiation of gametophytes. Heterospory is noticed in a few pteridophytes. They are *Selaginella*, *Isoetes*, *Stylitis*, *Marsilea*, *Pilularia*, *Regnellidium*, *Salvinia*, and *Azolla*. Heterospory existed in fossil pteridophytes such as *Calamostachys*, *Archaeopteris*, *Stauropteris* and *Lepidocarpon*. This condition was initiated along several distinct phyletic lines.

Heterospory is of considerable interest because it has a bearing on the evolution of seed. It is thought that seed plants were derived from heterosporous plants. Heterospory brings in a new type of gametophyte that is **endosporic** which is a biological advancement over **exosporic** gametophyte of **homosporous** plants.

4-2 ORIGIN OF HETEROSPORY

Heterospory is probably derived from the **homosporous** condition. Evidence from fossil pteridophytes indicate that heterospory of an advanced level was attained by them.

Barniophyton belonging to upper Devonian period attained for the first time a **free-sporing heterospory**. **Free-sporing heterospory** refers to a stage in which spores are **heterosporous** but produces **exosporous** gametophytes. In *Calamostachys* both homo as well as heterosporous conditions existed. The next step was reduction in the number of megaspores. In *Archaeopteris* the microsporangium contained large number of microspores, while megasporangium contained 4 to 48 megaspores. Further degeneration of megaspores took place in *Stauropteris*, where the tetrad consisted of two large functional spores and two small degenerate spores. The reduction in megaspore number was greater in *Lepidocarpon* where three spores of each tetrad were aborted.

In *Selaginella* itself the number of megaspores is small pointing a gradual reduction from 8 (*S. apus*) to one megaspore (*S. rupestris*). This indicates that a progressive reduction in number of spores has taken place till and finally a single large well nourished spore is the sole product of each megasporangium.

4-3 FACTORS THAT INDUCE HETEROSPORY

Paleobotanical and experimental evidences confirm that heterospory has arisen due to disintegration of spores so that surviving spores have better nutrition. Goebel observed that poorly illuminated *Selaginella* produced only microsporangia. Shattuck (1910) studied the influence of nutritional and environmental factors on *Marsilea*. He found that cold treatment of Sporocarp of *Marsilea* resulted in production of aborted microspores and the megaspores. When such plants were allowed to grow under favourable conditions, the remaining and surviving microspores enlarged upto 16 times their normal size. The largest of these in size resembled the megaspore. Pettitt (1970) observed that in the megasporangium of *Marsilea* certain sporocytes accumulate plastid like cytoplasmic organelles more than others. This megasporocyte is distinct from others. During meiosis, the factor responsible for accumulation of these organelles is passed on to one spore and the other spores abort. Brooks (1971) indicated that the formation of megasporangia is under the control of ethylene. These experiments confirm that nutritional and environmental factors possibly influence the development of heterospory.

4-4 IMPORTANCE OF HETEROSPORY

In homosporous pteridophytes the spores germinate on the soil producing the gametophytes. The gametophyte leads an independent life. So it is subjected to the external environment. More over it has to support the developing embryo by supplying nutrition until the embryo establishes itself as young sporophyte. There are advantages in heterospory. They are :

- (1) Female gametophyte develops within the large megaspore and derives nourishment from the food made by the sporophyte.
- (2) It is not exposed to the external environment.
- (3) The embryo is also saved of the problem of independent life as it is well protected by the wall of the sporangium and is assured of continuous food supply.

4-5 SEED HABIT

Bower (1917) considered that heterospory is the first evolutionary step towards the establishment of seed habit. Heterospory is probably derived from homospory due to changes in nutritive relationships. The evolutionary stages leading to the development of seed habit are :

1. Production of two different kinds of spores (heterospory).
2. Reduction in the number of megaspores to a single megaspore within the megasporangium.
3. Retention of the megaspore within the megasporangium.
4. Development of female gametophyte within the megaspore.
5. Fertilization of the egg and formation of embryo *in situ*.
6. Elaboration of the apex of megasporangium for receiving the microspore.
7. Formation of integuments with a micropyle.

Seed habit is a landmark in the evolution of vascular plants. It has brought biological advantages favourable for increased precision in the establishment of new individuals. The seed habit was also initiated on several phyletic lines. It is quite evident in fossil Lycopodiales such as *Lepidocarpon* and is called **incipient seed habit**. The megasporangium retained a megaspore. It was covered by an integument leaving a micropylar slit. The nearest approach to seed like habit is present in *Selaginella*. It shows heterospory. The megaspore usually germinates within the megasporangium. There is reduction to one functional megaspore (*S. rupestris*). In *Selaginella rupestris* the embryo maintains connection with the parent plant until it develops root and cotyledons (*Vivipary*). However there is no seed formation in *Selaginella* due to lack of the following characters :

1. There is no integument for the megasporangium.
2. The retention of the megaspore within the megasporangium has not been established.
3. There is a lack of resting period after the development of the embryo.

The essential point in the seed habit is the retention of megaspore within the tissues of the parent plant after fertilization. This is followed by higher degree of independence with regard to the process of fertilization and ensuring continuous supply of nutrition to the embryo upto an advanced age by the parent plant. These are the important steps in the establishment of Land flora.

Questions

1. Write a general account of heterospory and seed habit.
2. Write short notes on :
 - (a) Factors influencing heterospory.
 - (b) Origin of heterospory.
 - (c) Advantages of heterospory.

proto stele 1°

Siphonoclad.