Dormancy and Germination of Seeds

⇒ Dormancy of seeds :-

Dormancy is the condition of a seed when it fails to germinate even though the normal environmental conditions for growth are available.

⇒ Factors Causing Dormancy of Seeds :-

1.) **Dormancy due to seed coats :-** Seed coats are composed of a complex mixture of Poly-saccharides, hemicellulose, fats, waxes, and proteins. During seed ripening the seed coat becomes dehydrated and forms a hard tough protective covering around the embryo.

→ Because of the following properties the seed coat cause barrier for the seeds to germinate;

- Gas impermiability.
- Water impermiability.
- Mechanical resistance.

2.) Dormancy due to condition of embryo-

Seed dormancy due to condition of embryo may be of two kinds:-

1.) In the first case, the embryo are immature when the seeds ripe i.e. the embryoes are rudimentary and poorly developed. Further development of these embryos occurs during the period of dormancy.

2.) In the second case, although the embryo are fully developed when the seeds mature, but they are unable to germinate promptly. Such seeds can be induced to germinate if they are stored in moist, well aerated and low temperature conditions.

3.) Dormancy due to specific light requirement.

- The seeds of certain species e.g. Lactuca Sativa (lettuce), Nicotiana tabaccum (tobacco) have a light requirement for germination.
- Germination of water imbibed lettuce seeds is stimulated by red light (wavelength of 660 nm) and is inhibited by far-red

light (wavelength of 730 nm).

4.) Dormancy due to chilling requirement :-

- Seeds of many temperate plants, such as peach, plum, cherry etc. require a chilling (low temperature) treatment before they become capable of germinating.
- The chilling treatment is achieved in such plants under natural conditions during winter.
- The most suitable temperature for chilling treatment is 0-5°C.

5.) Dormancy due to germination inhibitors :-

- A large number of chemical substances have been isolated from the seeds.
- Some of them inhibit seed germination, while others promote growth.
- Substances like phenolics, tannins, alkaloids, ammonia releasing substances, cyanide releasing substances present in the seed covering, block the growth of embryo.
- If the inhibitors are leached out, inhibition

is removed and the seed germinate.

⇒ Methods of Breaking Seed Dormancy:-

1) Scarification:- The dormancy of seeds caused by hard seed coat, can be removed by breaking, softening or weakening of the seed coats. The method employed in softening and weakening the seed coat is called Scarification.
- For example:- Various mechanical and chemical treatments have been used to prompt the germination.

2) Imbaction:-
- In some seeds water and oxygen are unable to penetrate because entry is blocked by a cork like filling in the small opening in the seed coat.
- These seeds are shaken vigorously to remove the plug. The treatment is called imbaction.
e.g. Melilotus alba.

3) Stratification:-

- The dormancy caused due to condition of embryo have been noticed in the seeds of rosaceous plants (peach, apple, plum, cherry etc).
- These seeds will not germinate until they have been exposed in well aerated, moist condition under low temperature (0° to 10°C) for weeks to months. Such a treatment is known as Stratification.

4) Alternating temperature:-

- Germination of some seeds is strongly promoted by alternating daily temperatures.
- The difference between the alternating temperatures should not be more than 10-20°C.

5) Light:-

The seeds which respond to light for their germination, are known as photoblastic. There are three categories of such seed:-

1.) Single exposure of light promotes seed germination (Positive photoblastic seeds)

2.) Light inhibits seed germination i.e. seeds require complete darkness for germination (negative photoblastic seeds) and.

3) Seeds germinate in either light or dark (non-photoblastic seeds).

eg: lettuce is a light sensitive seed and it will not germinate in complete darkness untill it gets a single exposure of red light (660 nm). Far-red light, on the other hand, inhibits germination.

⇒ Seed Germination:-

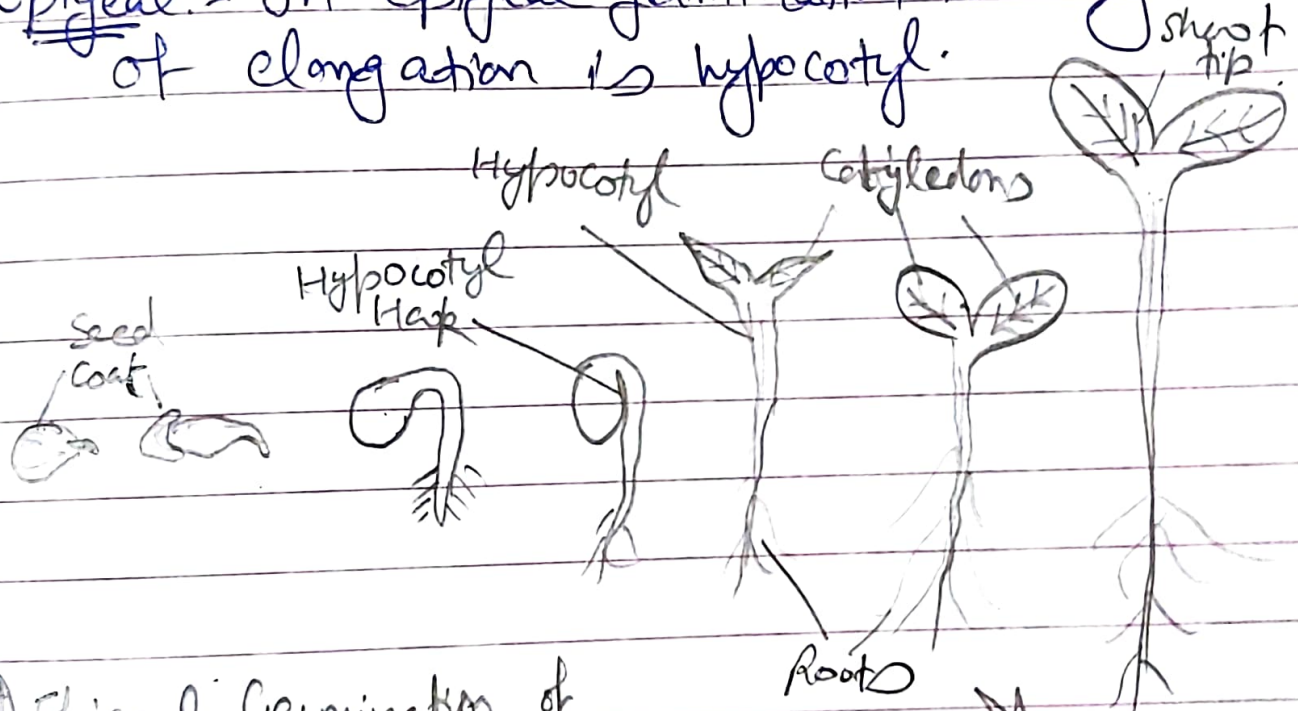
Seed germination is defined as the sum of events that begin with hydration of the seed and culminate in emergence of the embryonic axis (usually the radicle) from the seed coat.

Types of Germination :-

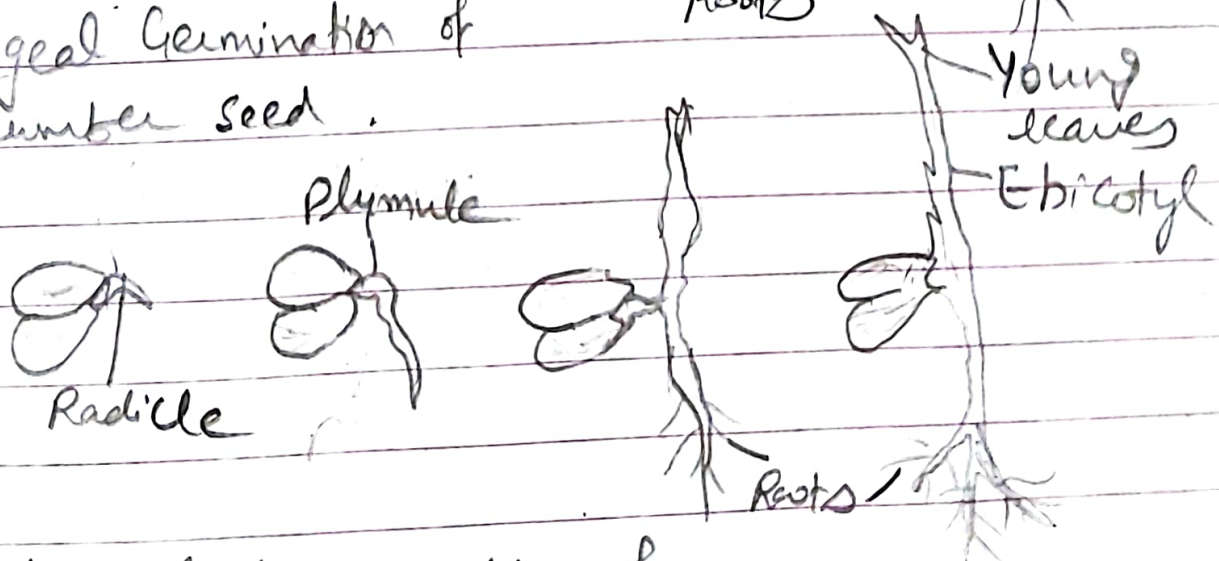
Germination of seed is of two types :-
a) Hypogeal and b) Epigeal.

a) **Hypogeal** :- In case of hypogeal germination the region of elongation is epicotyl.

b) **Epigeal** :- In epigeal germination the region of elongation is hypocotyl.



(A) Epigeal Germination of Cucumber seed.



(B) Hypogeal Germination of Gram Seed.

→ Factors essential for Germination:-

There are a large number of factors or conditions which are needed for the germination of seeds. They are broadly divided into two groups - external factors & internal factors.

External factors:-

1) Water:- water provides sufficient hydration to the concentrated protoplasm and reserve food material. Water also brings about softening of seed coats and enhance respiration. Softening of seed coat helps radicle to emerge out.

2) Temperature:- Germination of seeds depends on the activity of protoplasm and enzymes. Therefore, it requires a temperature range where enzymatic activity is normal i.e. from 5° to 40°C. The optimum temperature range for seed germination varies between 25 to 30°C.

3) Oxygen:- If seed coats are hard, then it becomes difficult for seed to

respirate and hence germinate.

4.) Light :- Light is not as essential factor for the germination of most of the seeds but some light sensitive seeds do require light as an important factor.

- The seeds which are not influenced by presence or absence of light are called nonphotoblastic (e.g. Maize, Bean etc.)
- Where as those which are influenced by presence or absence of light are called photoblastic.
  - In some cases, the seed germination is inhibited in presence of light. They are called negative photoblastic (e.g. Onion, Lily etc.)
  - Some seeds require presence of light for germination. They are called positively photo-blastic (e.g. Lettuce).

Internal factors:-

1.) **Maturity of embryo:-** In some plants, the embryo are immature when the seeds ripe and shed. These seeds germinate only after maturation of their embryos.

2.) **After ripening:-** Freshly formed seeds of some plants are unable to germinate promptly. They can be induced to germinate if they are stored in moist, well aerated and low temperature conditions. This is called after ripening.

3.) **Viability:-** Viability is the capability of a seed to germinate. It ranges from a few day (e.g. Oxalis) to more than one hundred years (e.g. Trifolium). They fail to germinate when their period of viability is over.

4.) **Dormancy:-** Seed dormancy may be caused by individual or a combination

of various factors such as toughness and impermeability of seed coats, mechanical resistance, germination inhibitors etc. Such seed germinate only after their period of dormancy is over.

⇒ Stages of Seed Germination:-

It has mainly 3 stages:-

a) Pregermination
b) Germination
c) Post germination.

a) Pregermination:- It consists of following events-

(i) Rehydration- imbibition of water.
(ii) RNA & protein synthesis stimulated.
(iii) Increased metabolism - increase respiration.
(iv) Hydrolysis (digestion) of food reserves by enzymes.
(v) Changes in cell structure.
(vi) Induction of cell division and cell growth.

b.) Germination:- It consists of following events.

(i) Rupture of seed coat.
(ii) Emergence of seedling, usually radicle first.

c.) Post-Germination:- It consists of following events.

(i) Controlled growth of root and shoot axis.
(ii) Controlled transport of materials from food stores to growing axis.
(iii) Senescence (ageing) of food storage tissues.