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Germination: The Way of Entering into a New Life

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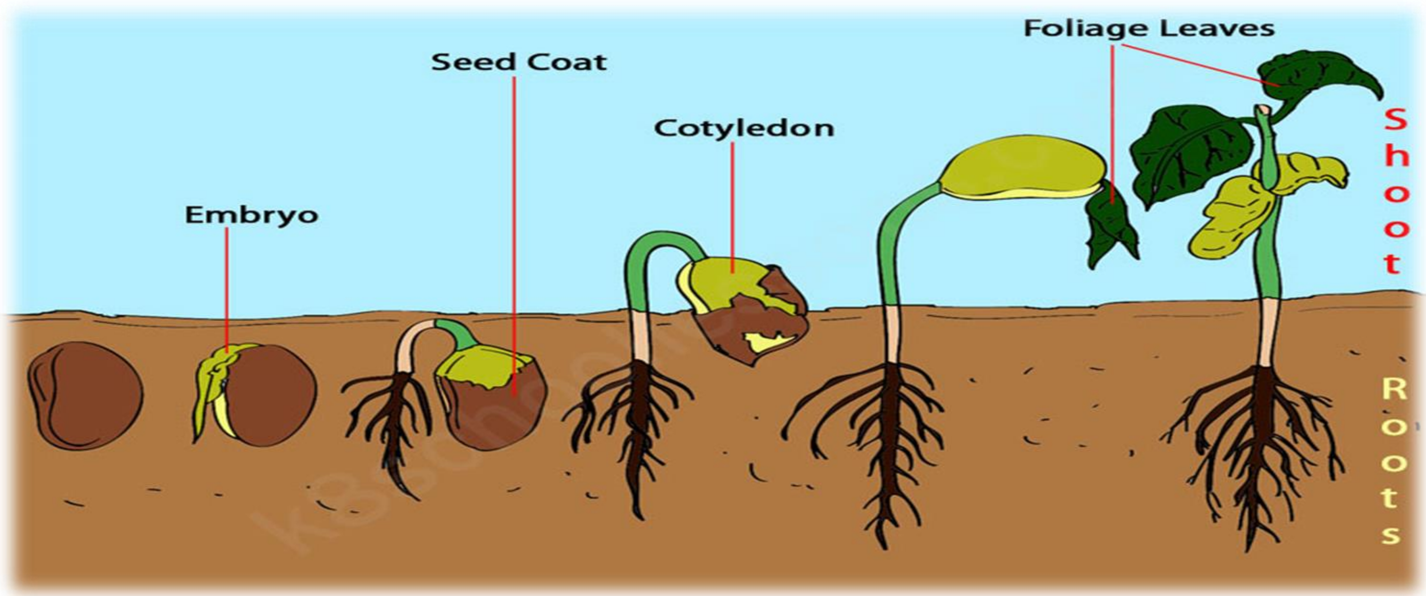
SUMMARY

Germination, a distinct feature of the life cycle of plants, is involved in the reanimation of the quiescent but viable system, which in turn leads to the establishment of a fully active and metabolizing organism. The present article is going to provide a concise knowledge on the general concept of germination, the mechanism underlining seed germination process, several biotic and abiotic factors having direct or indirect effects on seed germination, and different types of germination processes. The prediction of different germination characteristics under different changing environmental conditions may also be assessed going through this article and future programs in this field of research may also be set accordingly to get a better plant productivity.

INTRODUCTION

Germination is the beginning process of growth and development of embryo which is active after imbibition. It is driven by the ability of the plant embryo, embedded within the seed, to resume its metabolic activity in a sequential manner and it is the process of seeds developing into new plants (Bewley and Black, 1994). First, environmental conditions trigger the seed to grow. Generally, this is determined by the depth of the seed planted inside the soil, water availability and temperature. When water is in adequate amount, the seed absorbs water in a process called imbibition. The water activates specific enzymes that begin the process of seed growth (Bradford, 1995). At first the seed grows a root to get an access of underground water. Next, the shoots, or growth above ground, begin to appear, where it will grow leaves to acquire energy from the sun. The leaves continue to grow towards the light source in a process called photo morphogenesis.



[Source: https://k8schoollessons.com/germination/]

Mechanism of Seed Germination

Generally, germination of seeds takes three phases.

Phase-I : Seed imbibition phase, in which quick water uptake involves in apoplastic spaces through forces driven by the Seed.

Phase-II : Activation Phase, in which re-establishment of metabolic activities (protein synthesis takes place) occurs.

Phase- III : Germination phase, where cell elongation and radicle emergence occurs. But before ending of Phase-II germination remains a reversible process because seeds may be dried again and remains alive during storage which re-initiate germination under suitable condition.

Factors Affecting Germination

A. External Factors

(i) **Water:** Water is required for germination. Most seeds need enough water to moisten the seeds but not enough to soak them. The uptake of water by the seeds is called imbibition.

- Imbibition depends on seed coat permeability, chemical composition of seed, availability of water and environment etc.
- Imbibition is the main process of germination though it's not related to viability of seed.
- When seeds are formed, plants store food reserve within the seed which provides nourishment to the growing embryo.
- During the imbibition of water, hydrolytic enzymes are activated which breakdown the food reserve into metabolically useful chemicals.

(ii) **Oxygen/ Aeration**:

- During germination metabolic activity of seeds remain high. So, oxygen is main ingredient of that metabolic activity, respiration.
- If the germinating medium is poorly aerated, it adversely affects the germination rate and germination percentage of the seed.

(iii) **Temperature:**

- Different seeds are germinated through utilization of different temperature (Guan *et al*., 2009). Very low and very high temperature can prevent the germination of seed.
- In general, seeds of cool-season crops germinate best at relatively low temperature of 8-15 °C.
- Whereas, Optimum temperature for germination of seeds in tropical region varies from 20- 30 °C.
- Rate of growth of seedling and rate of germination increases with a rise of temperature but it is up to a certain level.

(iv) **Light:**

- It has no direct effect on germination. Different types of seed show different types of response.
- Insufficient light on seed can enhances the chances of physiological dormancy of seed.

(v) **Pathogenic Organisms:**

- Pathogenic organisms on the seed surface may cause low germination and rotting of seedlings.
- The situation is known as damping-off and it is aggravated by high moisture and high temperature condition.

B. Internal Factors

(i) Plant growth regulator and nutrients:

- Different plant species stores different biomolecules as a reserve material for germination such as oil seeds reserve fat, legumes reserve protein. These molecules are reserved and some are synthesized either in endosperm or in cotyledon.
- Presence of auxin and gibberellins are essential for promoting growth during germination. At initial stage hydrolytic enzymes are synthesized in presence of GA_3 for mobilizing the stored material.
- Besides presoaking of seeds in GA-3 often cause faster germination of many dormant seeds (Groot and Karssen, 1987).

(ii) Resting period:

- Many seeds can't germinate immediately after maturity even if provided with all favorable external condition for germination. This condition is known as resting period on dormancy (Vleeshouwers *et al*., 1995).
- The seeds in certain plant may not have sufficient amount of growth hormones required for the growth of the embryo. Therefore, they require some time span during which the hormones get synthesized (Cohn, 1996).

(iii) Viability:

- Seed viability is the ability of the embryo to survive, grow and develop into a seedling under favorable condition.
- Viability period is crop specific; it may range from a few weeks to many years. Seeds germinate before the ending of their viability period after which the embryo becomes dead.
- Storage condition in which the seed mature often determine the period of viability.

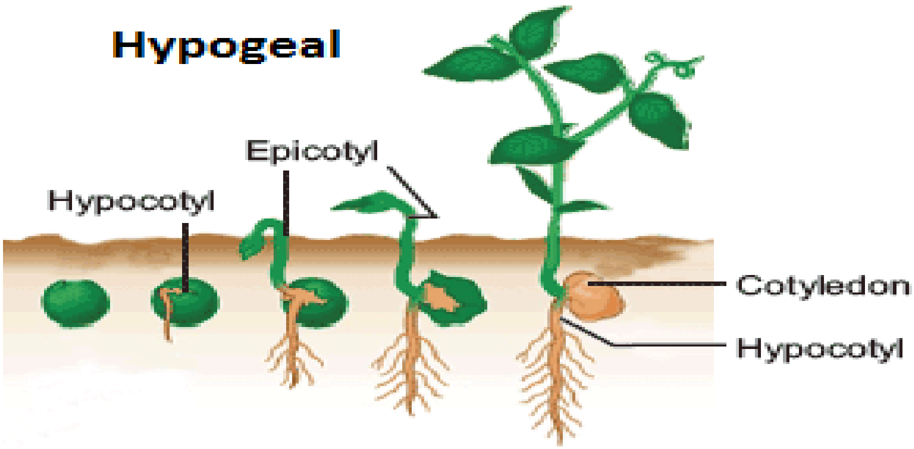
Types of Germination

(i) Hypogeous or Hypogeal germination:

Hypogeal germination implies that the cotyledons stay below the ground. The epicotyl (part of the stem above the cotyledon) grows, while the hypocotyl (part of the stem below the cotyledon) remains in the same place where the seed was first placed. The hypocotyl neither move to upward nor transforms into 1st pair of leaves of the seedling. Then the radicle comes out and follow geotropism. In the meantime, the Epicotyl pushes the plumule above the ground.

Example of Hypogeal Seeds-

Albuminous Seed	**Ex- Albuminous Seed**
Monocot : Rice, Maize, Barley	Monocot: Vallisnaria sp
Dicot: Water Lilly (Nyphus sp)	Dicot: Gram, Pea



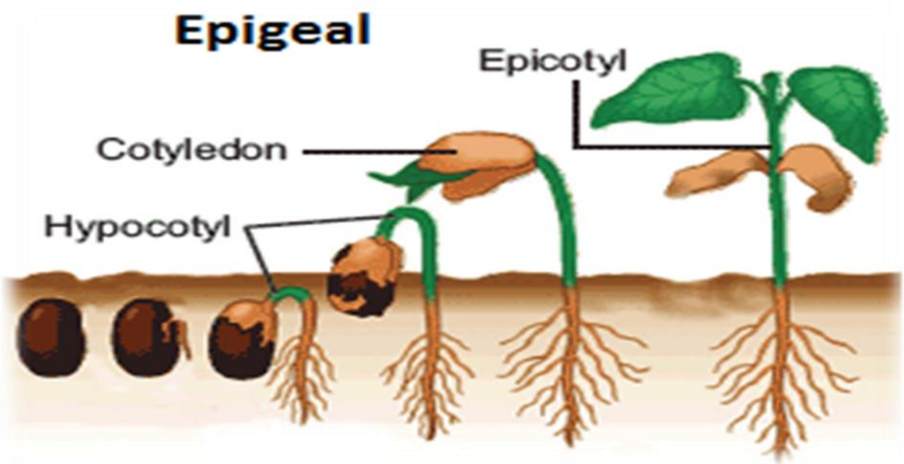
[Source: https://vivadifferences.com/10-difference-between-epigeal-and-hypogeal-germination-with-examples/]

(ii) Epigeous or Epigeal Germination:

Epigeal germination implies that the cotyledons are pushed above ground. The hypocotyl elongates while the epicotyl remains the same place where the Seed was first placed. Cotyledon emerge above the soil surface by elongation of hypocotyl and generally becomes green. The radicle comes up and bends down to earth. The development of plumule to form shoot is delayed a bit.

Example of Epigeal Seed-

Albuminous Seed	**Ex-Albuminous Seed**
Monocot: Onion (*Allium sepa*)	Monocot: *Alisma plantago*
Dicot: Castor (*Ricinus Communis*)	Dicot: Pumpkin, Gourd, Bean



[Source: https://vivadifferences.com/10-difference-between-epigeal-and-hypogeal-germination-with-examples/]

(iii) Viviparous Germination:

Viviparous germination is a special type of germination found in mangrove plants, which are salt-loving or halophytes. In viviparous germination, the seeds germinate while still attached to the parent plant. The embryo of seed undergoes development without any resting period with the fruit and is still attached and nourished by the parent plant.In this type embryo grows out not only from seed but emerges out from the fruit. So the radicle grows and comes out to a considerable length. Finally, the seedling grows and falls vertically on the mud and gets embedded on it.

Example of Viviparous Seed- Rhizophora, Bruiguiera, Kandelia, and Ceriops etc.

[Source: https://www.quora.com/What-is-plant-viviparity]

CONCLUSION

The data that available on germination is already a substantial volume. The basic concept of germination along with its different types and their mechanisms is well known and these have also been studied in a wide range. But what is little bit lacking is the valuable information regarding the use of biotechnological as well as molecular biology tools through which the enhancement of the germination process from the embryo-root level and the development of stress tolerant seed can be done. Therefore, a vast area of research is there in this field through which we can proceed towards a better knowhow on establishing an improved germination process in plants so that they can withstand and grow effectively under this changing global climate.

REFERENCES

Bewley, J.D. and Black, M. Seeds: Physiology of Development and Germination. New York: Plenum Press; 1994.

Bradford, K.J. Water relations in seed germination. In Seed Development and Germination, J. Kigel and G. Galili, eds. New York: Marcel Dekker; 1995: pp. 351-396.

Cohn, M.A. (1996) Operational and philosophical decisions in seed dormancy research. Seed Science Research: 6: 147-153.

Groot, S.P.C. and Karssen, C.M. (1987) Gibberellins regulate seed germination in tomato by endosperm weakening: A study with gibberellin-deficient mutants. Planta: 171: 525-531.

Guan, B. (2009) Germination responses of Medicago ruthenica seeds to salinity, alkalinity, and temperature. Journal of Arid Environment: 73: 135-138.

Vleeshouwers, L. M., Bouwmeester, H. J. and Karssen, C. M. (1995) Redefining seed dormancy: an attempt to integrate physiology and ecology. Journal of Ecology: 83: 1031–1037. doi: 10.2307/2261184