MINISTRY OF HIGHER EDUCATION, SCIENCE AND INNOVATION
GULISTAN STATE UNIVERSITY

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THE SEED AND THE SEEDLING ARE THE INITIAL STAGES OF THE ONTOGENY OF THE FLOWERING PLANTS

Gulistan - 2024

Karshibaev H.K. The seed and the seedling are the initial stages of the ontogeny of flowering plants – Gulistan, 2024.- 16 p.

The content is prepared according to the Botany training programof the Bachelor of Biology. The topic "Seed, embryo and seedling - the initial stages of ontogeny of flowering plants" is devoted to the process of formation of the seeds of flowering plants. It highlights the process of seed formation, endosperm, germination of seeds, the period and stages of germination, conditions that prevent germination, hard-seeding and the causes of its origin. The lecture is aimed at bachelors of the biological direction.

This content is recommended for publication by the Educational and Methodological Council of Gulistan State University (protocol ...from ...2024).

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THE SEED AND THE SEEDLING ARE THE INITIAL STAGES OF THE ONTOGENY OF THE FLOWERING PLANTS

Purpose: The students to get acquainted with the initial stages of ontogeny of flowering plants.

PLANE :

1. Seed. Origin of the seed parts in ontogenesis.
2. Endosperm.
3. The structure of the embryo. Seed testa.
4. Seed dormancy.
5. Types of germination.

1. Seed. Origin of the seed parts in ontogenesis.

The seed is a mature ovule (ovules after fertilization), which contains an embryo, a supply of nutrients, a protective seed testa, which emerged from the integuments.

Archaic seeds form multilayered, histologically differentiated covers, arising from two integuments. Evolving evolutionarily those seeds, the seed covers of which are formed from one integument.

Endosperm develops from two polar nuclei merged with the nucleus of the sperm in the central cell of the embryo sac. So, the endosperm is triploid. Perisperm is a nocellular sporophyte tissue. But in many dicotyledons these tissues are short-lived and completely or partially absorbed by the developing embryo even before the seed goes to rest. In this case, the supply of nutrients is contained in the tissues of the embryo, especially in the cotyledons.

Depending on the place of storage of nutrients, the following types of seeds are distinguished:

1. Spare substances are contained in the cotyledons. Then the seed consists of seed testa and embryo. The embryo is straight or curved, occupying a central position. This type of seed is characteristic of dicotyledons in representatives of the family *Fabaceae, Asteraceae, Brassicaceae.*

2. Spare substances are found in the embryo and in the endosperm. Then the seed consists of seed testa, embryo, endosperm.

3. Nutrients are stored only in the endosperm. Then the seed consists of seed testa, embryo and well developed endosperm. Examples: representatives of the family *Poaceae, Liliaceae.*

4. Spare substances are deposited in the endosperm and perisperm. The seed consists of seed testa, embryo, endosperm and perisperm. Representatives of the family *Banana*, *Ginger*, *Pepper*.

5. Spare substances are found only in the perisperm. The seed consists of seed testa, fetus, perisperm. This type of seed is not characteristic of monocots. Examples in the plants of the family *Caryophyllaceae, Nymphaeaceae.*

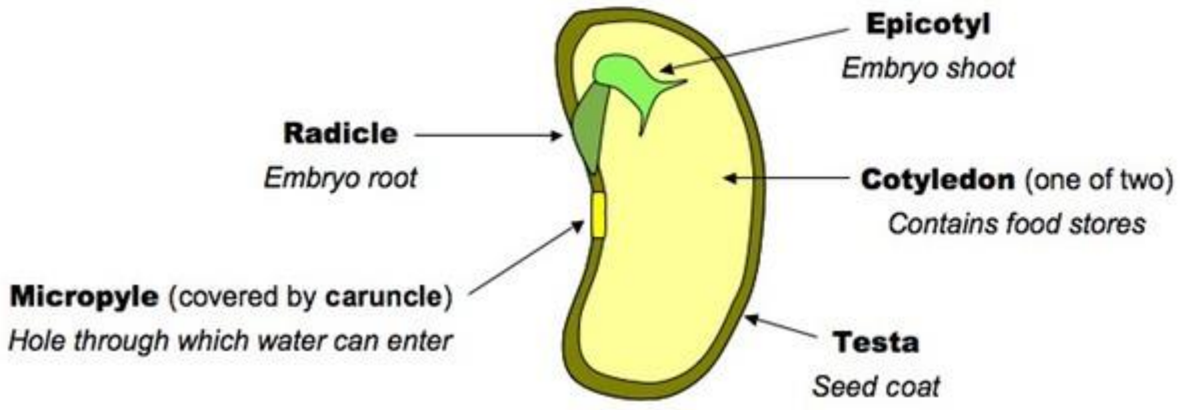

Fig. 1. The anatomy structure of seed dicotyledonous plants

During the evolution of angiosperms, endosperm reduction occurred in mature seeds and a corresponding increase in the size of the embryo. In more primitive angiosperms, we observe abundant endosperm and a very small embryo with a little developed kidney. In evolutionarily advanced groups, the embryo grows, and the endosperm is reduced and even disappears.

Reduction of endosperm is associated with an increase in the size of the embryo. The presence of a larger embryo creates the possibility for the deposition of reserve substances in the very bud - in its cotyledons. This is a significant progress, because nutrients deposited in cotyledons are more accessible to the germinating fetus than the food of the surrounding endosperm.

2. Endosperm

There are three ways of forming endosperm: nuclear, cellular and gelobial.

In the nuclear endosperm, as a result of free nuclear fission, many nuclei are formed. Endosperm remains non-cellular or later there are cellular membranes. In the cellular endosperm, the formation of cell membranes begins simultaneously with the first mitosis and continues as the endosperm grows. In the gelobial endosperm, the embryonic sac is divided into two unequal cells, of which the large chalazal develops in a non-cellular manner, and the small micropilar is behaving differently. Gelobial type is found mainly in monocots.

The main nutrients stored in the reserve are carbohydrates, proteins, lipids. The seed contains all types of compounds, but their relative quantity in plant seeds of different taxa is not the same.

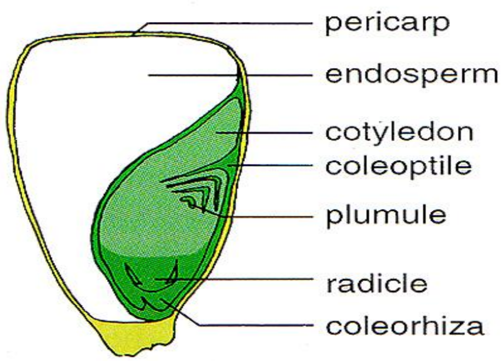

Fig. 2. The anatomy structure of seed monocotyledonous plants

3. The structure of the embryo

Zygote by numerous mitotic divisions is transformed into a multicellular embryo consisting of a primary shoot, a primary root and one or two cotyledons. The number of cotyledons - one in monocotyledons and two in dicots - is regarded as the main feature by which these two classes of angiosperms differ.

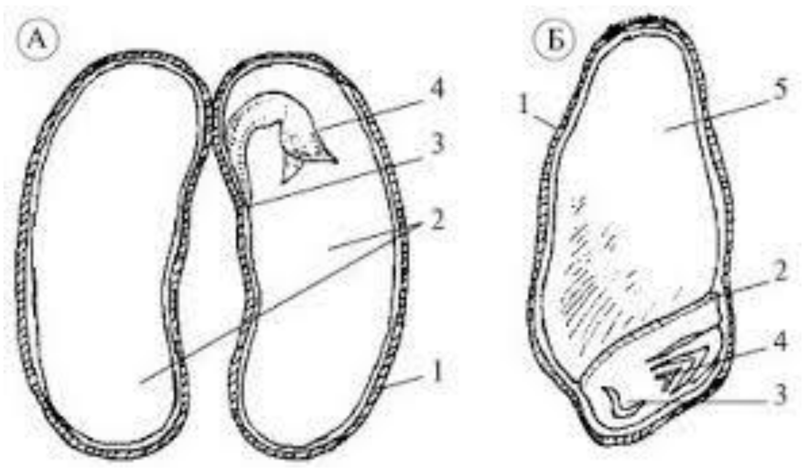

Fig. 3. The anatomy structure of seed dicotyledonous (A) and monocotyledonous (B) plants: 1- seed coat (testa); 2-coteleodon; 3-radicle; 4- embryo shoot; 5-endosperm.

Cotyledons are located on the embryonic axis, on opposite ends of which are apical meristems of shoot and root. In the bud, the apical meristem is located at the apex of the epicotylus - the pericameral axis. In some cases epicotyl is represented only by this meristem, in others it carries a certain number of young leaves. Together with these leaves it is called the embryonic kidney.

The hypocotyl is called the cotyledons. The lower part of the hypocotyl passes into the embryonic root.

In monocotyledons the cotyledon usually performs the function of absorption, rather than storage. Immersed in endosperm, it absorbs nutrients that are broken down by enzymes. These nutrients migrate to the cotyledons to the growing zones of the embryo. The germ of cereals belongs to the more highly differentiated among monocotyledons. In its form, it has a cotyledon (scute), adjacent to the endosperm. The scutellum is attached to one side of the embryonic axis, at the lower end of which there is an embryonic rootlet, on the upper side there is an embryonic kidney. Both the embryonic root and the embryonic kidney are surrounded by vaginal-like protective structures - colerosis and coleoptera.

The part of the axis between the shield assembly and the coleoptile is the mesocotile. In some cereals, a small outgrowth is formed opposite the scutellum - the epiblast.

It is believed that in the process of evolution, a monocotyledonous embryo appeared as a result of underdevelopment of one of the two cotyledons of typical dicotyledonous plants. Hence, the emergence of monocotyledons is associated with the general simplification and reduction of all ontogeny.

How does the embryo develop?

The early stages of embryonic development in dicotyledons and monocots are similar. Formation of the embryo begins with the division of the fertilized egg (zygote) in the embryo sac of the ovule. In most flowering planes, the first division plane runs across the longitudinal axis. At the same time, the polarity of the embryo is established: the halazal pole is the main center of further growth, the embryo itself develops from the cells formed at this pole. The micropylar pole fulfills by nature only a vegetative function. Forms a kind of leg - suspension, or suspension, which anchors the embryo of the micropyle.

It used to be believed that suspensions help the movement of the embryo into nutrient tissues. This happens in gymnosperms. It is established that the flower buds are also actively involved in the absorption of nutrients from the endosperm. In some cases, the protein substances synthesized in the suspension are used by the embryo itself during its rapid growth.

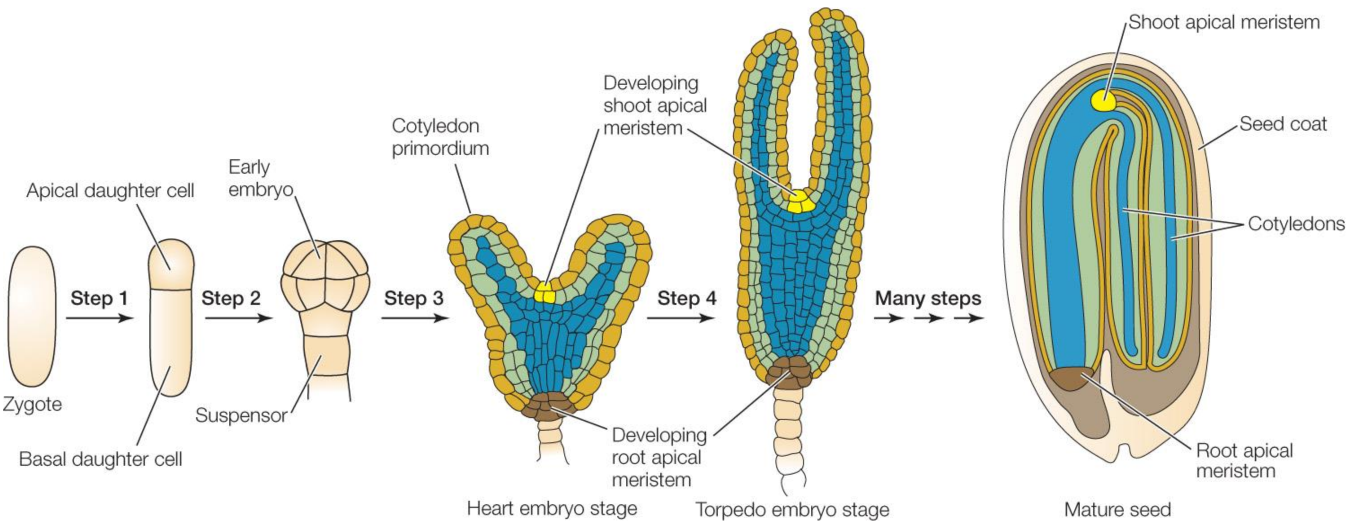

Fig. 4. Origin of the embryo and seed parts

Until the moment when, as a result of divisions, the embryo differentiates into a germ and a suspension, the whole structure is called a proembryo. Once the dicotyledons show signs of the formation of two cotyledons, the axial symmetry is replaced by the bilateral one. This change in symmetry is regarded as the end of the stage of the proembrio.

Before the beginning of the growth of the cotyledons, a flattening of the embryo is observed. In this case, the globular embryo gradually acquires a two-bladed shape, which leads to bilateral symmetry. This stage of development of the embryo is called heart-shaped. Because the embryo of monocotyledons has only one cotyledon, it does not have a heart-shaped stage.

The halazal cells of the suspension begin to degenerate even at the stage of the heart-shaped embryo and eventually crumble with the expanding embryo.

Thus, in embryogenesis, escape and root are laid as a single structure, evolving from a zygote.

Seed testa* (*coat, spermoderma)

Seed testa (seed coat) is formed entirely from the integuments. Usually the Spermoderma has a complex histological structure. It has a mechanical layer in which there are sclerides or fibers, a parenchyma layer that can be juicy. In many species, the seed testa is very hard and slightly permeable to water. The micropyle is preserved on the testa in the form of a small hole. Usually micropyle is adjacent to the hem. The chicken remains on the skin after the separation of the seed from the funicular. In anatropic ovules, the part of the funicular that has attached to them remains in the form of a seed suture.

The external features of seeds are the size, shape, the nature of the surface of the seed coat, the placement of the hem, the presence or absence of such structures as the seedling or arillus (the funiculum extension), the caruncle (the growth of the integration near the micropyle) and the eliosome (an oily appendage eaten by ants).

Seed with juicy cover is considered as evolutionarily primitive. They were replaced first by a seed with reduced fleshy parts (aryllus, caruncle, eliasome), attracting animals, and then a dry seed, which can be enclosed in a juicy fruit. The size of the seed is of ecological importance. In many species, small-seededness is a means of protection against eating seeds by animals. Melkosemyannost is associated with the ability of species to form permanent seed banks. In those species that do not have seed cans, the seeds are usually larger and often have pubescence and awns.

The seed coat protects the embryo in it and affects germination. The inhibition of germination is associated with a high degree of impermeability of the seed testa for water and oxygen. This is due to the presence of cuticular layers and their distribution. Seed testa can exert a mechanical resistance to the growth of the embryo. In the seminal peel, inhibitors of germination are localized.

Spermoderma is resistant to digestive fluid in animals.

The epidermis of some seeds contains mucus cells and, upon contact with water, swells and becomes sticky. Due to this, the seed sticks to the animals and is transferred to new growth sites or, on the contrary, sticks to the soil, and mucus protects from drying out.

Seeds are an important food product for animals and humans. Among the angiosperms, the representatives of the *Poaceae* family (cereals) are mostly used by man in comparison with the plants of other families. The second place is occupied by the family *Fabaceae* (beans). Seeds are used for making drinks (coffee, cocoa, beer), medicines, technical oils.

Because in the seed the primary stages of the development of a new sporophyte-the embryo-occur, then it is the seed that provides continuity between the successive generations of seed plants. Those. The seed is not an organ at all, but an organism, a whole daughter plant that originated on the mother plant.

After all, no one will think of a calf as a cow's organ, and a kitten is a cat's organ. And for some reason they are accustomed to enumerate the organs of the plant, along with the root and shoot, to call the seed.

4. Seed dormancy.

For the development of the embryo in the seed, certain environmental conditions are necessary: humidity, optimal temperature and oxygen. But even in the presence of these conditions, some, even mature seeds can not germinate until internal changes occur in them, the totality of which is called ripening.

The need for ripening prevents premature germination. For example, if a seed that had fallen out in the fall would sprout immediately, the sprouts would not survive the winter. There are mechanisms to ensure that the timing of germination coincides with the onset of a season favorable for growth.

So, the most common causes of seed dormancy are the physiological immaturity of the embryo, the mechanical hardness or impermeability of the seed coat for water or for oxygen, the presence of inhibitors of germination. That is why it is necessary to ripen, which in our temperate zone is stimulated by low temperatures in winter.

The seeds of many ornamental plants need a period of low temperatures. If the moist seeds are kept at low temperatures for several days or weeks, the rest can be interrupted and the seeds germinate. This technique is called stratification. Mechanical damage to the seed coat with a knife, sandpaper - scarification - contributes to breaking the state of "hardness" or removing the inhibitor and restoring the metabolic activity necessary for germination.

The ability to germinate after ripening seeds are divided into several groups.

1) the seeds germinate in the fruits that are on the mother's body. This is typical for mangrove plants on the ocean coasts, periodically flooded with water;

2) the seeds immediately germinate after falling, but germination does not last long, because The embryo is not sufficiently protected from drying by a thin seed coat. Under unfavorable conditions for germination, seeds die (poplar, willow);

3) the seeds are capable of immediate germination after falling off, but in the absence of suitable conditions, they remain viable for a long time. These are the seeds of most cultivated plants, weeds, meadow grasses;

4) the seeds do not germinate immediately after falling. The reasons for the delay are different: either a very hard seed coat and a time for softening the peel; or the processes of internal maturation have not ended and certain conditions (temperature, light) are necessary;

5) Fallen seeds contain nutrient and pre-embryo stocks, which are transformed into a fetus after separation from the mother plant. In natural conditions, the germination of such seeds occurs after wintering (hohlatka, chistyak, kalina);

6) a reserve of nutrients is stored in the seeds, there is a pre-germ, which is differentiated during germination. In nature, such seeds germinate in autumn, but the sprout remains in

the soil, and aboveground growth begins in the spring (anemone, kupena, majnik, lily-of-the-valley);

7) seeds have only pre-embryo and integument: germination and nutrition of the sprout at the primary stages of development is provided by symbiosis with the fungus. To this group belong the seeds of orchids.

Mature seeds in most cases are very dry (moisture accounts for 5-20%). Therefore, germination is impossible until the seed absorbs a certain amount of water necessary for metabolic activity. Water is absorbed through the micropyle and Spermoderma by absorption of water by colloids in the seed (proteins, starch, cell wall substances: hemicelluloses and pectins). The swelling of these substances creates a large force sufficient to rupture the seed coat. Subsequently, water moves from cell to cell under the action of osmotic forces. Water is necessary to activate biochemical processes associated with germination, because these processes take place in an aqueous solution. At the same time, already active enzymes are activated in the seed and new ones are synthesized that participate in the cleavage and use of nutrients accumulated during the embryo formation. The fission and extension of the cells is resumed in the bud.

So, the process of transition of a seed from a state of rest to an active life is germination. As a result, the fetus starts growing and forms a seedling.

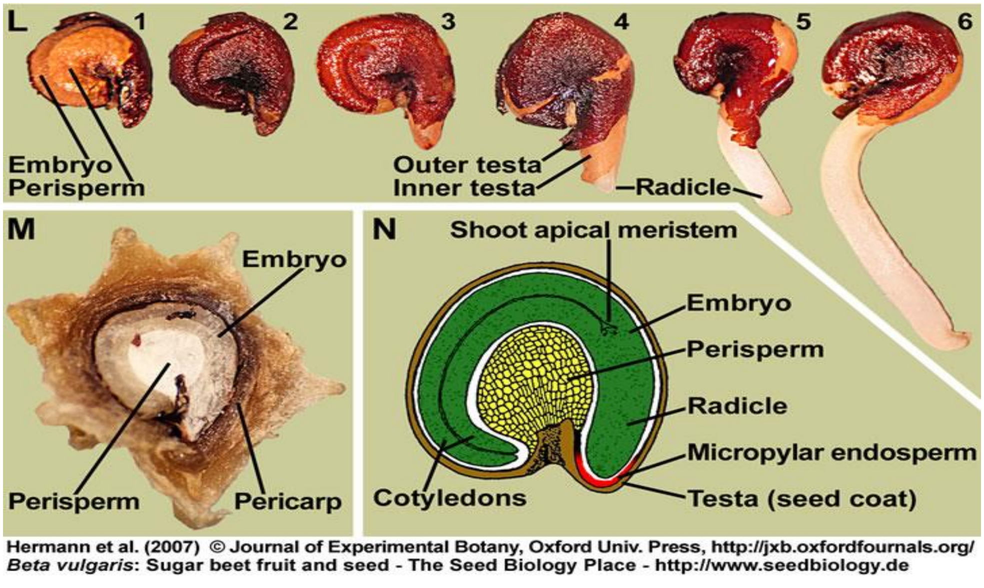

Fig.5. The appearance of the embryonic root (5-6).

The first visible sign of growth is the appearance of the embryonic root. The root fixes the seed in the soil and begins to absorb water.

In the process of growth, the rootlet is transformed into a primary root on which lateral roots of different orders are formed. This gives rise to a ramified root system. In monocotyledons, the primary root is short-lived, and the root system of an adult plant develops from subordinate roots, which are laid in the nodes.

5. Types of germination.

1. If, after the appearance of the root, the hypocotyl lengthens and curves, forming a loop, the shoot tip is pulled out of the soil without damage. This type of germination, in which the bent hypocotyl is straightened and takes the cotyledons to the surface, is called overground (*epigeal*).

2. In hypogeine germination the epicotyl curves. When it is straightened, the kidney rises above the surface of the soil, and the cotyledons remain in it, and eventually break down. This type of germination, in which cotyledons remain in the soil, is underground (*hypogeal*).

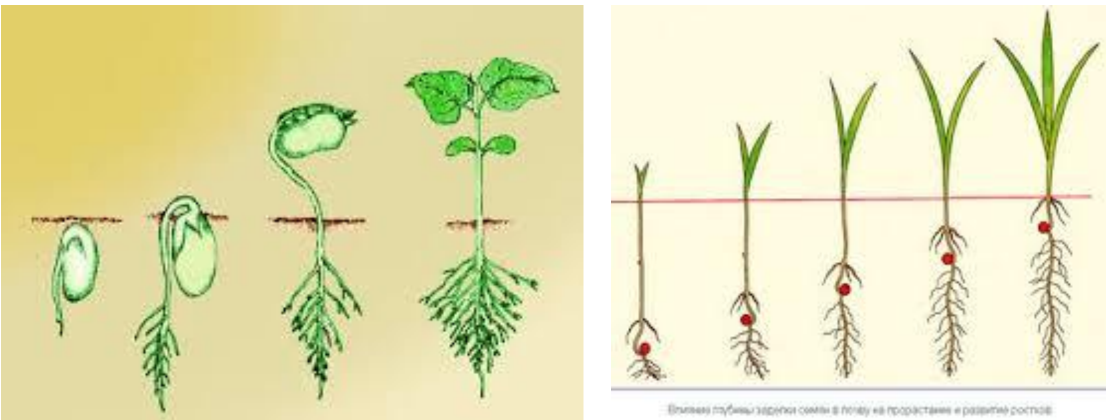

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Fig.6. *Epigeal* (1) and *hypogeal* (2) germination of plants.

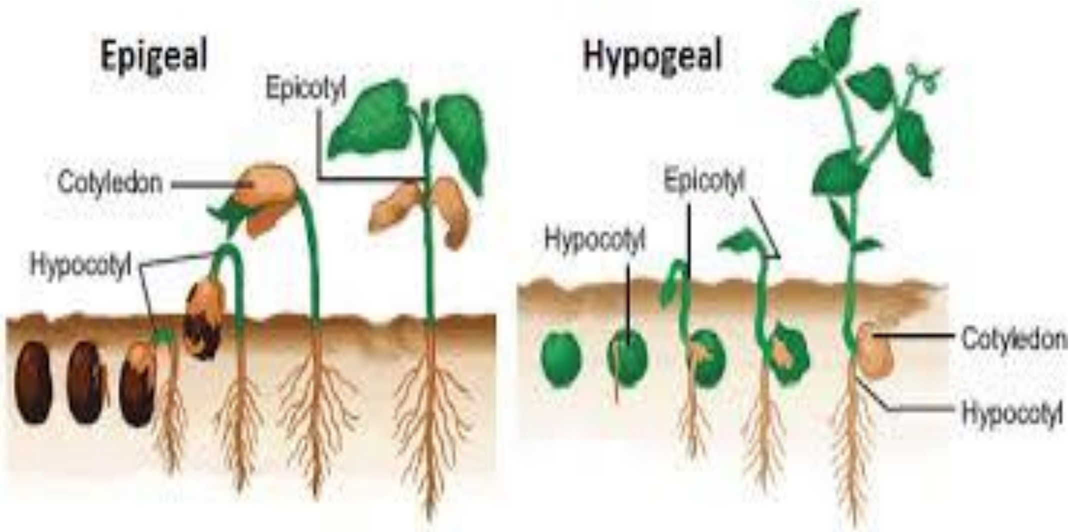

Fig.7. Epigeal and hypogeal germination of plants.

These types of germination are characteristic of dicotyledonous and monocotyledonous plants.

In monocotyledons the embryonic root and the embryonic kidney are protected by colyorization and coleoptile, respectively. The first during the germination breaks down klorizy. Behind it is the embryonic root, which quickly lengthens and emerges from the Coryorism. After the appearance of the primary root, the coleoptile is pushed out by the extension of the mesocotylus (the first "internode" between the "nodes" of the scutellum and the coleoptile). When the base of the coleoptile reaches the surface of the soil, its edges diverge at the apex, and primary leaves of the kidney appear from the soil.

Thus, a daughter sporophyte develops from the germinating seed, a seedling that retains the elements of the seed structure for a certain time, namely, the embryo (cotyledons) and is characterized by heterotrophic nutrition. Then heterotrophic and autotrophic, and in the juvenile phase - more autotrophic.

The period from germination to the transformation of a seedling into an independent organism is the most critical in plant ontogeny. At this time, the plant is most sensitive to damage, and a lack of moisture can lead to the death of the plant.

So, the embryo and the sprout are the initial stages of the ontogeny of the flowering plant.

GLOSSARIY

Atamalar		
Ingliz tilida	**O’zbek tilida**	**Atamaning ma’nosi**
apical	apikal	учки, тепа
basale	bazal	остки, пастки
monocotyledons (monocot)	birpallalilar	Гулли ўсимликларнинг синфи
gameta	gameta	гаплоид хромасомали жинсий хужайралар
hypocotyl	gipokotil	Майсанинг илдиз буғизидан то уруғпаллаларгача бўлган қисми
gynoecium	ginetsey	гулдаги уруғчилар тўплами.
flower	gul	шакли ўзгарган ва қисқарган новда
floral plants	gulli o’simliklar	Гулга эга бўлган ўсимликлар гурухи
zigote	zigota	уруғланган тухум хужайра
root	ildiz	Ўсимликнинг вегетатив органи
dicotyledons	ikkipallalilar	Гулли ўсимликларнинг синфи
integument	integument	уруғкуртак қобиғи
bud	kurtak	Новда бошланғичи
micropyle	mikropile	уруғкуртак интегументлари орасидаги чанг найи йўли.
radicl	murtak poyacha	Уруғдаги бирламчи поя бошланғичи
ontogenesis	ontogenez	организмнинг индивидуал ривожланиш жараёни
reproduction	reproduktsiya	(“re” – қайта, “produco” - яратиш) организмларнинг ўзига ўхшаш индивидларини ҳосил қилиш.
reproductive organs	reproduktiv organlar	ўсимликни кўпайишига хизмат қилувчи орган (гул, мева, уруғ).
devolopment	rivojlanish	Ўсимликнинг сифат жиҳатидан ўзгариши
spermoderma	spermoderma	Уруғ пўсти
ovule	urug’kurtak	Тугунча ичидаги жинсий тузилма
seed, semen	urug’	Генератив орган, репродукция жараёни махсулоти

seedling	o’simta	Уруғдан ҳосил бўлган ёш майса
main root	o’q ildiz	Ўсимликнинг вегетатив органи
plant	o’simlik	Ўсимлик оламининг вакили
plant structure	o’simlik strukturasi	Ўсимликнинг ички ва ташқи тузилиши
endosperm	endosperm	Озуқа туқимаси
embryo	embrion	Янги ҳосил бўлган организм
epicotly	epikotil	Майсанинг уруғпаллалардан то биринчи барггача бўлган қисми

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CONTROL QUESTIONS:

1. *The seed is ....?*
2. *What parts does the seed consist ?*
3. *What is the main function of the spermoderm?*
4. *What is the main function of the endosperm?*
5. *What is the biological role of seed dormancy?*
6. *The main stages of seed germination?*
7. *What factors are necessary for seed germination?*
8. *What is scarification?*
9. *What is stratification?*

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Terishga 26.01.2024 yil berildi. Bosishga 29.01.24 yilda
ruxsat qilindi. Bichimi 60 x 84, 1/16. Buyurtma № 18.
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