9. Seeds

Seeds are the consequence of mature ovules after each ovule in the ovary has been fertilized by sperm from the pollen grain, to form a zygote. Aspects of seed morphology can be important systematic characters used in plant identification and separation. Some valuable aspects of seed morphology are size and shape, together with the color and surface features of the seed coat.

9.1. Seed structure (figure 1.65)

The **seed coat** (**testa**), the outer protective covering of seed derived from the integument(s). The **hilum** shape, size, and color are of taxonomical value, the **raphe**, a ridge on the seed coat formed from an adnate funiculus. Some seeds have an **aril,** the seed is arillate in this case. Caruncles also function in animal seed dispersal, with regard to seed dispersal by ants. Specific details of the **embryo** can be studied, these include aspects of the **cotyledon**(s) the first leaf or leaves of the embryo, often functioning in storing food reserves, **plumule** and **radicle**. **Epicotyl** zone is the transitional region between the plumule and cotyledon(s) **hypocotyl** zone, under the cotyledon(s) fusion point and the radicle.

All angiosperms form endosperm, the food reserve tissue. The typical angiosperm seed is **albuminous** or **endospermous**, having endosperm as the food reserve in mature seeds. In some angiosperms endosperm develops, but very little to none is deposited in mature seeds, a feature termed **exalbuminous** or **nonendospermous**, **cotylespermous** are the plants the main food reserved is stored in the cotyledons.

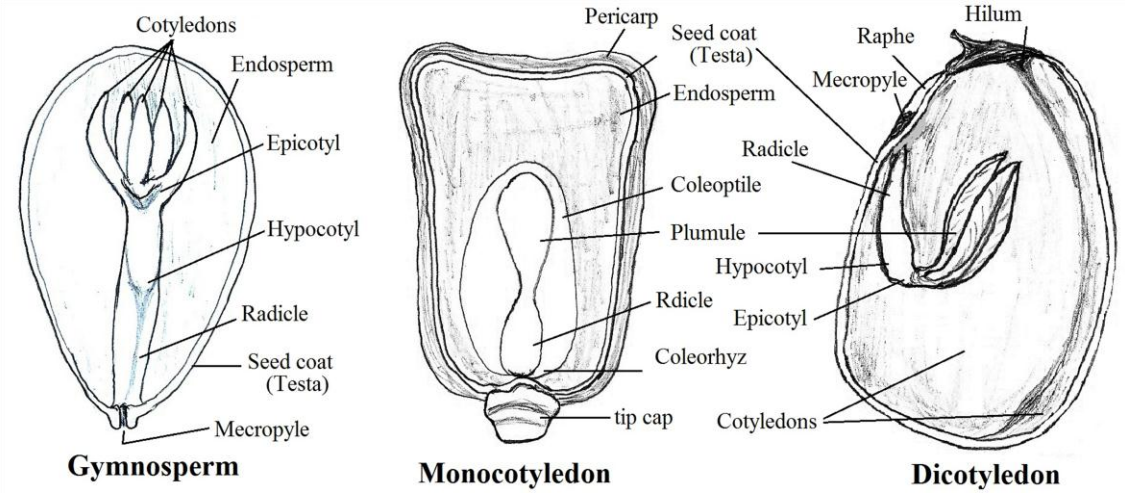

Figure 1.65: General structure of seeds

9.2. Seed color

Color pattern is a measure of the distribution of colors on an object. Common color pattern terms are **maculate**, spotted, with small spots on a more or less uniform background; **pellucid**, having translucent spots or patches; and **variegated**, with two or more colors occurring in various irregular patterns.

9.3. Seed size

Measuring the size of plant organs and parts is important in description and identification. Generally, size of parts refers to linear measurements, as in leaf length or corolla width. Metric units should be used throughout.

9.4. Seed shape

The shape is an important feature in plant description and identification. The seeds may take different shapes, including irregular, or sometimes have different appendages such as thorns and hooks … etc., or they may be regular and called the same shapes that are used for bracts, sepals, petals, stamens and pistils, the main seed shapes are **Globoid, Ovoids**, **Oblate**, **Ellipsoid**, **Angular**, **Reniform**, **Lenticuler**, **Discoid**, **Clavate** and **Capitate** (figure 1.66).

Figure 1.66: Different shapes of seeds

9. 5. Seed germination types

Seed germination type requires observation of young seedlings during germination and describes positioning of the cotyledons. **Hypogeous** (**hypogeal**, **cryptocotylar**) refers to a type in which the cotyledon(s) remain in the ground during germination. **Epigeous** (**epigeal**, **phanerocotylar**) has cotyledon(s) elevated above the ground during germination (figure 1.67).

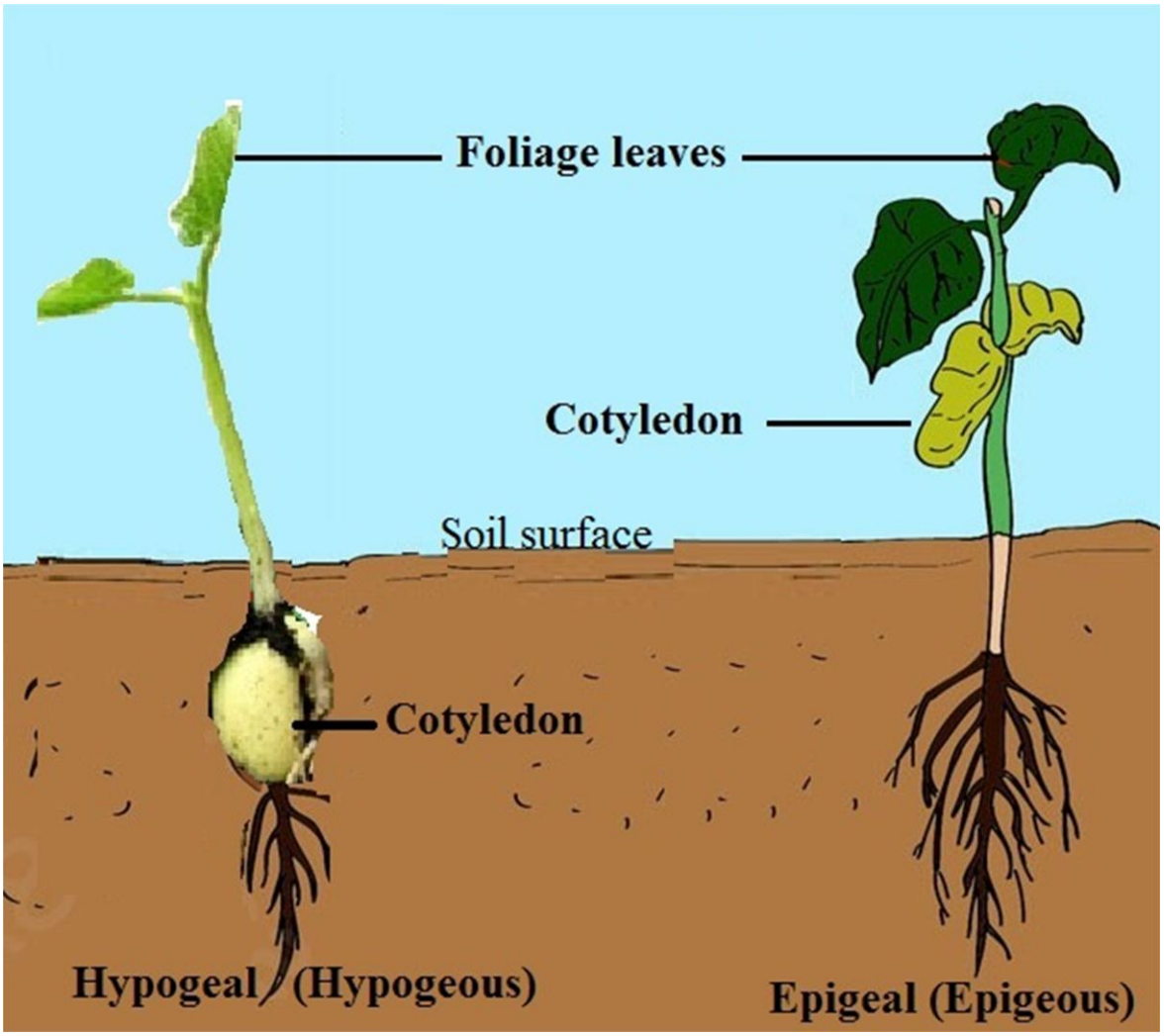

Figure 1.67: Types of seed germination

9.6. Seed dispersal aids

Seed dispersal is the movement of seed from one region to another, such as the transport of a seed or fruit (by wind, water, or bird) from a continent to an island (figure 1.68).

The concepts of seed dispersal are discussed by Murray (1986) and Fahn and Werker (1972). Animals (zoochory; chory from chorein - to wander), wind (anemochory), water (hydrochory), and the plant itself (autochory) assist seed dispersal. Van der Pilj (1972) divided **zoochory** into three groups:

(1) Endozoochorous plants where the seeds are ingested by animals and pass through the digestive tract without damage.

(2) Epizoochorous plants where the seeds adhere to the fleece, coat or feathers of animals and then loosen and fall to the ground.

(3) Synzoochorous plants where the seeds are collected and cached for feeding.

Endozoochory: In endozoochory, various animals such as fish, reptiles, birds and rodents eat seeds. These seeds typically possess attractive features to animals such as color, odor, and abundance of storage materials and large size. Many fruits, for example, dramatically change color from green to red, blue or black as they mature, which contrasts them against the green foliage. This morphological change assures easy visibility to the foraging animal, signifies that the fruit is ripe and simultaneously ensures that the seeds are mature and capable of reproduction. Other fruits such as *Citrus* emit appealing aromas that attract animals. The type of storage material (carbohydrates, lipids, proteins, etc.) and the size of the fruit are also important nutritional attributes that animals consider when foraging for food.

Epizoochory: In epizoochory, seeds develop at least two animal-adhering mechanisms that assist their dispersal: (1) hook-like spines and (2) sticky substances. Hook-like spines are usually more common in the fruit than the seed, but they can also be found on seeds (Fig. A). The hairs and bristles of some seeds that assist in wind dispersal also cling to animals. Sticky substances such as mucilage extruded from moistened seed coats allow the seed to adhere to a passing animal in the morning when dews are present, and then be deposited elsewhere when the mucilage dries later in the day. Mucilage production is common in seeds from the Brassicaceae, Lamiaceae, Asteraceae and Plantaginaceae. Genera that produce abundant mucilage include *Salvia* and *Plantago.*

Synzoochory: In synzoochory, seeds are collected and stored by animals for nutritional reasons. In some cases, the nutritional part of the seed is a fleshy appendage called an elaisome that can be easily detached from the remainder of the seed, which is hard and inedible. Examples of this include *Acacia* and *Viola* seeds where ants (myrmechory) harvest the seeds, carry them to their nests where the elaisome or attractive appendages are separated from the seed, and the undesirable seeds discarded (Fig. B).

Anemochory: In anemochory, wind is the most effective of all seed dispersal agents. Appropriately, seeds have developed specialized structures to assist their dispersal by air. These include small seed size, balloons, plumage and wings. Seed size is important in wind dispersal because very small seeds can be transported in air just like dust. These seeds often contain undeveloped embryos and small storage reserves. Examples include members of *Gypsophila, Pyrola, Sedum, Campanula, Digitalis* and *Orobanche* genera. In other seeds, such as orchids, a balloon-like sack surrounds the small seed, which is only one to a few layers thick. This causes the specific weight of the seed to decrease and the surface area to increase facilitating movement of the seed through the air. Plumed seeds have trichomes or hairs covering their surface. Examples include *Asclepias, Salix* and *Populus.* The cypsela of the Asteraceae also produces a feathery pappus (Fig. C). Winged seeds can also possess one sided wing such as maple or ash seeds or wings that surround the seed such as beech and elm seeds and are flattened in one plane or curved. The shape of the wing determines how the seed moves in the wind. The wings are usually large, but small in weight and relatively rigid.

Hydrochory: In hydrochory, seeds are dispersed in water because they possess a specialized air-filled tissue that allows the seed to be buoyant in water. This tissue can contain:

(1) Spongy, intercellular spaces filled with air.

(2) Air-filled cells in differing parts of the fruit such as the lignified air-filled cells of the mesocarp in coconut.

(3) An aril that encloses the seed as an air-filled sack that functions as a swim bladder.

Autochory: In autochory, plants have developed mechanisms to disperse their own seeds ballistically. This can occur by the explosive opening of the fruits or the springing of a trip lever in a fruit that ejects the seed (Fig. expulsion).

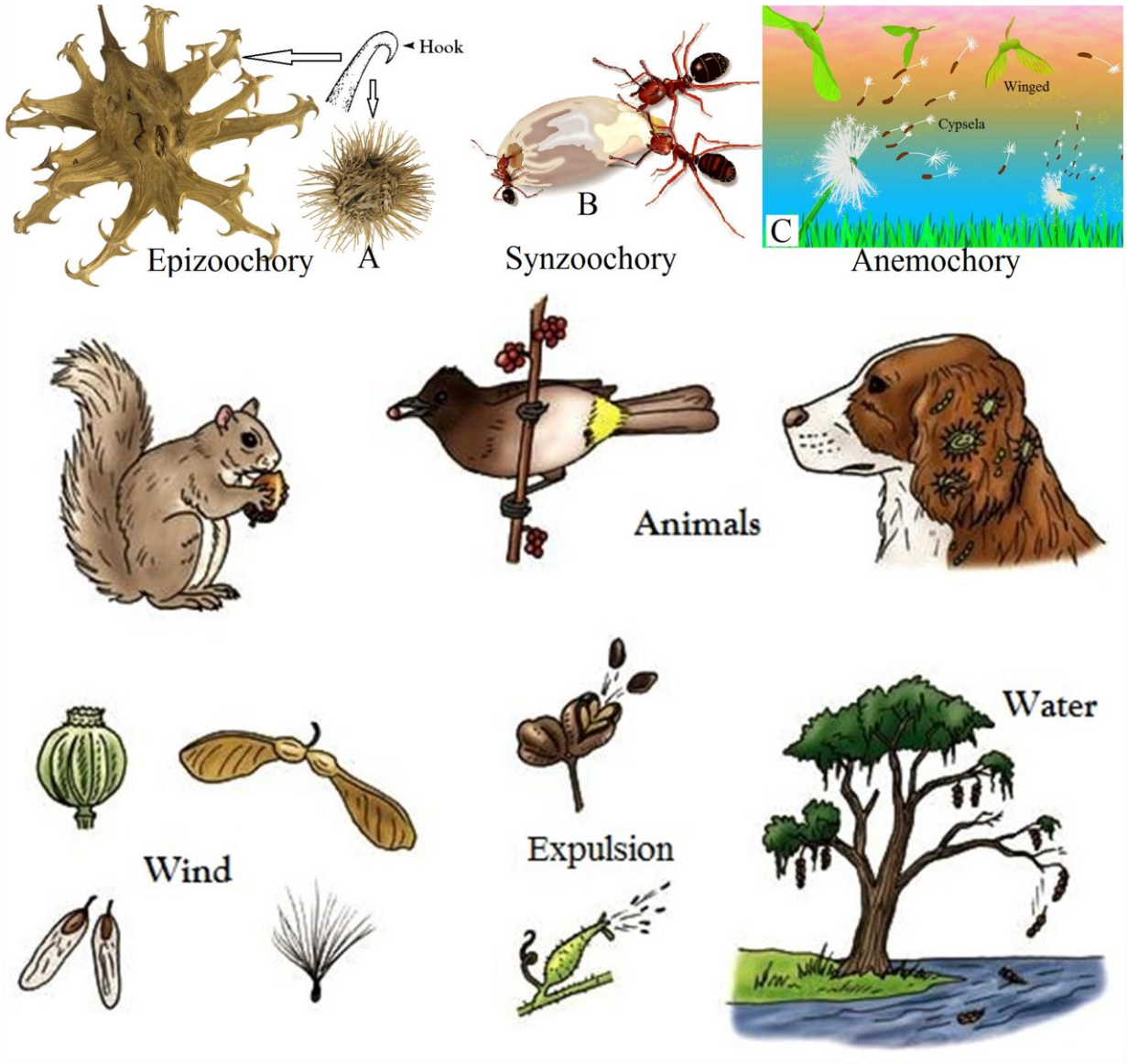

Figure 1.68: Various aids for seed dispersal