THE STEM

The stem, an essential component of a plant, constitutes the ascending part of the plant axis responsible for bearing branches, leaves, flowers, and fruits. Typically growing above the ground, the stem is recognized as the aerial segment of the plant. Its origin can be traced back to the plumule of the embryo within the germinating seed. During the initial stages of development, the stem exhibits a green coloration, indicating its youthful state, but undergoes subsequent transformations, becoming woody and adopting a dark brown hue as maturity ensues.

The stem is characterized by the presence of nodes and internodes, pivotal features that contribute to its overall structure. Nodes represent the regions on the stem and its branches where leaves are consistently positioned at regular intervals. In contrast, internodes denote the segments of the stem located between two adjacent nodes. This organized arrangement of nodes and internodes facilitates the growth and distribution of leaves along the stem.

Bearing a fundamental role in the stem's developmental process are buds, which can manifest as either terminal or axillary. A bud is specifically defined as a young, immature, and compact shoot that is underdeveloped. Two primary categories of buds exist on the stem:

- **Terminal Bud (Apical Bud):** Positioned at the tip of the stem, the terminal bud plays a crucial role in steering the growth of both the stem and its branches. Also referred to as the apical bud, it acts as a key driver of vertical development.
- **Axillary Bud:** An axillary bud is situated in the axil, a space formed between the upper part of the stem and the point where a leaf attaches. This bud is named axillary due to its association with the axil, and its presence contributes to lateral branching and overall plant development.

Functions of the Stem

- The stem serves as a structural framework that not only carries but also provides support to leaves, flowers, and fruits, contributing to the overall architecture of the plant.
- One of its vital functions involves the conduction of water and mineral salts from the roots to the leaves and fruits, facilitating the essential processes of nutrient transport and absorption.
- Additionally, the stem plays a pivotal role in the intricate system of nutrient distribution within the plant. It acts as a conduit for transporting the food manufactured in the leaves through photosynthesis to various parts of the plant, including the roots, fruits, and specialized storage organs. This function ensures a balanced allocation of nutrients, supporting the growth and sustenance of different plant organs.

Modifications of Stem

The stem of certain plant species undergoes modifications that enable them to fulfill specific functions, aiding the plants in adapting to prevailing environmental conditions. These modifications manifest in various forms:

- **Underground Stem:** The typical aerial nature of the stem is altered in some plants to create an underground structure dedicated to storing food materials. This adaptation helps the plant endure adverse conditions and serves as a means of perennation. Examples include:

  Rhizome: It extends parallel or horizontally along the soil surface, featuring nodes, internodes, buds, and scaly leaves. Examples include ginger, banana, turmeric, and ferns.

  Tuber: The terminal section of an underground stem branch swells due to food accumulation. Examples encompass potatoes and Jerusalem artichoke (Helianthus tuberosus).

  Corm: Growing vertically beneath the soil, the corm is typically unbranched and possesses nodes, internodes, buds, and scale leaves. Examples involve colocasia, gladiolus, colchicum, crocus, and amorphophallus (zaminkand).

Bulb: In this modification, the stem takes on a reduced, disc-shaped form. The bud is encircled by concentric scale leaves, with the inner ones being fleshy and edible, and the outer ones being dry. Examples include onions, lilies, and garlic.

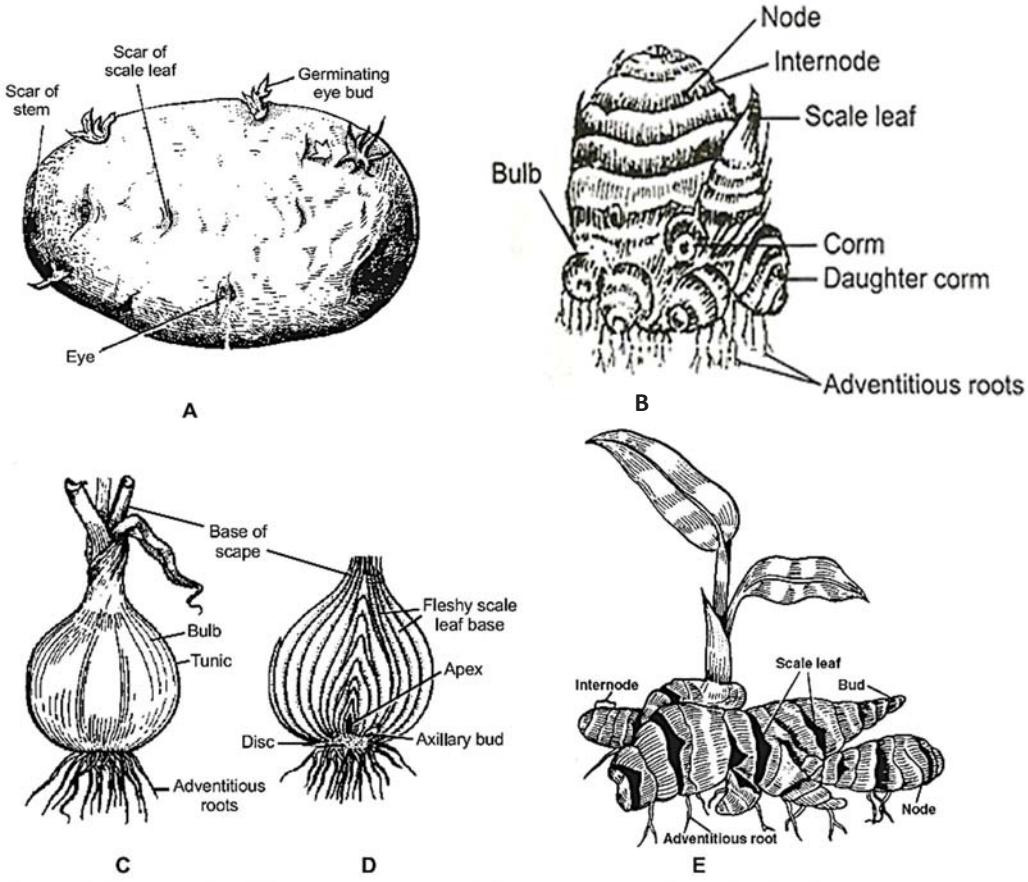

Fig. : Underground modifications of stem: A. Tuber of potato; **B.** Corm of *Colocasia* **C, D.** Tunicated bulbs of onion (**C,** entire; **D,** longitudinally cut) **E.** Rhizome of ginger

- **Stem Tendrils:** In certain plant species, the axillary buds located on the stem undergo modification to develop into specialized structures known as tendrils. These tendrils exhibit distinct characteristics, being elongated, slender, thread-like, and spiral-coiled, displaying sensitivity. Functioning as climbing organs for the plant, tendrils exhibit a remarkable ability to coil around adjacent supports. Their primary role is to provide support to the fragile and delicate stem of the plant. Notable examples of plants featuring stem tendrils include grapevines and various gourds such as pumpkins, watermelons, and cucumbers.

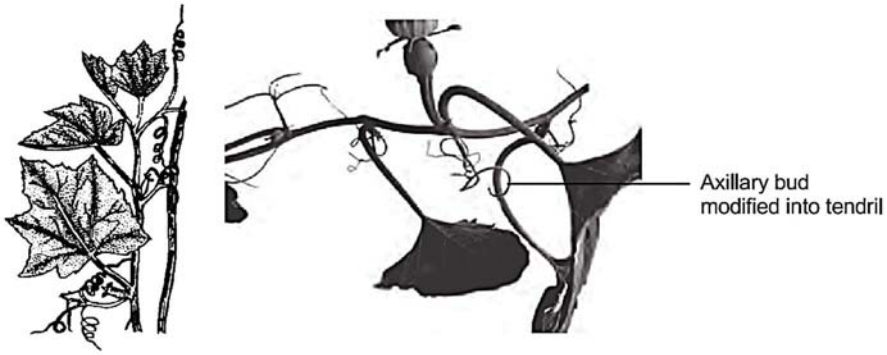

Fig. : Stem tendrils in cucurbits

- **Thorn:** In specific plant species such as Citrus and Bougainvillea, the axillary buds undergo a unique modification where they forfeit their capacity for growth, transforming into rigid, woody structures characterized by pointed tips, commonly referred to as thorns. These thorns serve a crucial protective function, acting as deterrents against browsing animals. The robust and sharp nature of thorns provides an effective defense mechanism, safeguarding the plants from potential harm caused by herbivores.

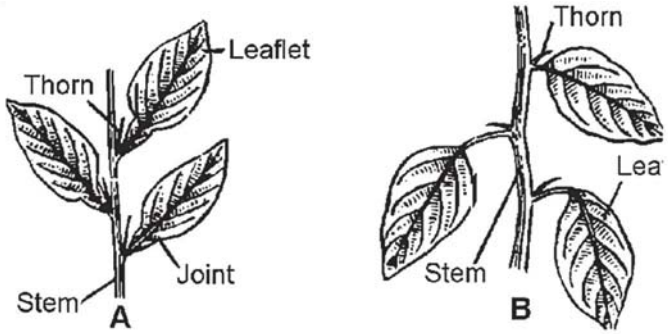

Fig. : Stem Thorns : A - *Citrus*, B - *Bougainvillea*

- **Sub-aerial Weak Stem**

  Offsets: Certain aquatic plants, exemplified by Pistia and Eichhornia, exhibit a unique vegetative propagation strategy through structures known as offsets. In these plants, a lateral branch is developed with distinctive characteristics, featuring short internodes. Along these lateral branches, the spatial separation between adjacent nodes is notably reduced. At each node along the lateral branch, a rosette of leaves forms above, while concurrently, a cluster or tuft of roots emerges below. This specialized arrangement facilitates the generation of new plant individuals through the development of offsets, contributing to the propagation and expansion of these aquatic plant species.

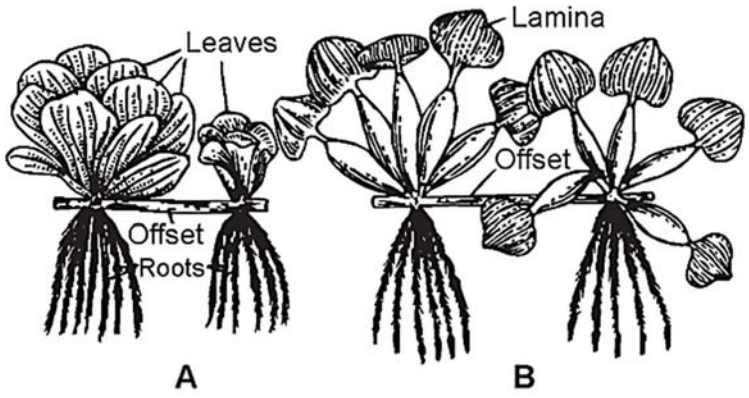

Fig. : Offsets : **A -** *Pistia*, **B -** *Eichhornia*

Suckers: Certain plant species, including banana, pineapple, and Chrysanthemum, employ a distinctive method of vegetative propagation known as suckers. In these plants, lateral branches originate from the basal and subterranean sections of the main stem. These lateral branches exhibit subterranean growth, extending beneath the soil for a certain distance before emerging obliquely to develop into aerial shoots. The formation and growth of suckers represent a key mechanism through which these plants reproduce vegetatively, contributing to their ability to propagate and expand within their respective habitats.

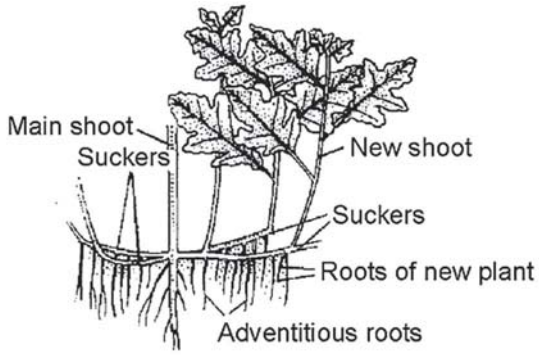

Fig. : Suckers of *Chrysanthemum*

Runners: Runners, a form of specialized plant structures, are characterized by their elongated and prostrate nature. These branches exhibit distinct features such as long internodes, the segments between nodes, and the presence of roots at these nodes. Notable examples of plants that employ runners as a mode of propagation include various grass species and Oxalis. In the case of runners, the elongated and horizontally spreading branches facilitate the establishment of new plants at nodes where roots can develop, contributing to the vegetative reproduction and expansion of these plant species.

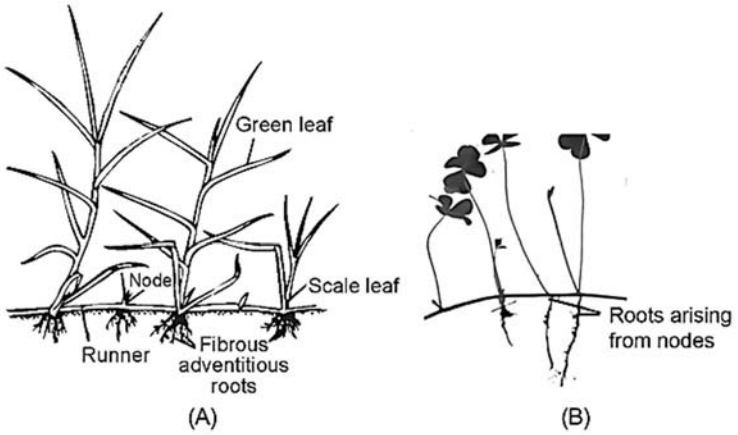

Fig. : Runners: (A) Grass, (B) *Oxalis*

Stolons: Stolons represent a distinctive type of lateral branch observed in certain plant species, such as mint and jasmine. Originating from the base of the main axis, these slender branches undergo an initial phase of aerial growth before arching downwards to eventually make contact with the ground. This characteristic growth pattern enables stolons to function as specialized structures for vegetative propagation. Jasmine and mint are examples of plants that utilize stolons as a means of reproducing and expanding their population. The arching and subsequent rooting of stolons contribute to the establishment of new plants, fostering the overall growth and spread of these particular plant species.

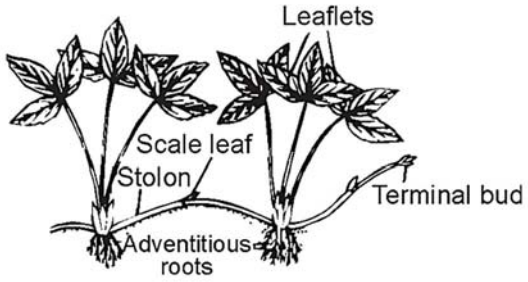

Fig. : Stolon

- **Aerial Stem:** Certain plant species thriving in arid environments showcase a distinctive adaptation where their stems undergo modification into either flattened structures, as observed in Opuntia, or fleshy cylindrical forms, exemplified by Euphorbia. These modified stems are referred to as phylloclades and are characterized by their green coloration resulting from the presence of photosynthetic pigments. Unlike conventional stems, these structures exhibit unlimited growth potential and actively participate in the process of photosynthesis, contributing to the plant's overall energy production.
- **Cladode:** Another noteworthy modification observed in certain plants involves the transformation of the stem into a leaf-like structure specifically designed for photosynthesis. This modification, known as cladode, typically consists of a single internode and serves as a site for photosynthetic activity. Simultaneously, the traditional leaves of these plants undergo reduction, often manifesting as scales or spines. Examples of plants exhibiting cladodes include Asparagus and Ruscus, where this adaptation enhances their ability to capture and utilize light for energy production while adapting to specific environmental conditions.