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Significant Floral and Fruit Morphology of Angiospermic Plants

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ABSTRACT: The most significant patterns, in terms of evolutionary relationships, involve reproductive structures, such as the number and arrangement of flower parts, or the structure of cones. While the size and shape of vegetative structures such as leaves and stems are relatively plastic or changeable, the basic patterns of reproductive structures change little over time. Although access to flowers and fruit may be seasonal, digital resources and herbarium samples allow the identification of patterns and relationships within plant taxa.

For the majority of angiosperms, when a flower is pollinated, the pollen joins with an egg to produce a seed. The seed develops within the ovary which is part of the pistil, a female reproductive organ of the flower. The expanded and ripened ovary is referred to as the fruit. Commonly, the enlarged ovary becomes the edible portion of the fruit.
In addition to an important feature for identification purposes, many fruit types have decorative value and may provide long season interest in the landscape. The morphology of different fruit types can be examined

For the majority of gymnosperms, the cone is the reproductive structure. Most familiar is the female cone, which is constructed of many small, rounded, scale-like structures attached to a central stem. The pollen bearing male cone is characteristically smaller than the female cone. Typically, a naked seed will develop on each of the scales of a female cone.

I. INTRODUCTION

A typical angiosperm flower is borne on a peduncle (stalk) and is composed of the receptacle, sepals (calyx), petals (corolla), stamens, and pistil (carpel). Flower parts may be fused or separate and usually exhibit radial (star-shaped) symmetry or bilateral (two-mirror image halves) symmetry

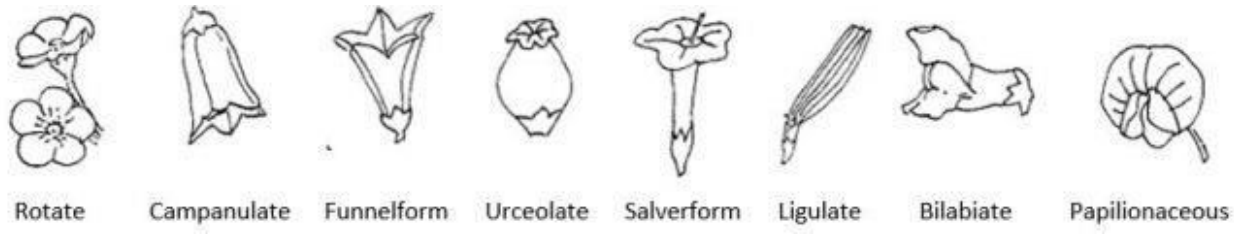

Figure1 Flower corolla shapes.

Flower shape, color, and markings are all valuable features for plant identification.

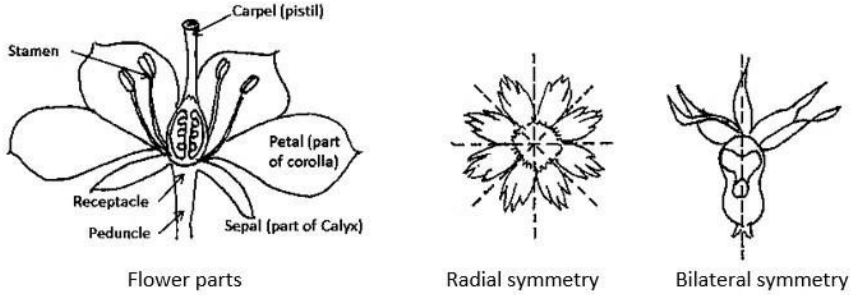

Figure 2 Flower parts and symmetry.

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 5.928

| Volume 4, Issue 6, June 2021 |

In addition to their shape, flowers are often differentiated by further dissections of their structure. For example, complete flowers must have all four main flower parts: sepals, petals, stamens (male) and pistils (female), while incomplete flowers will be missing one or more of these parts. Most flowering plants have perfect flowers that contain both male and female reproductive parts. However, some have imperfect flowers that contain only the male or female part (stamen or pistil) and may or may not contain sepals or petals. A species may have individual plants that are dioecious, producing either male or female flowers or cones on separate plants. Plants that are monoecious produce both female and male flowers and cones on one plant. [1]

Angiosperms produce flowers which are arranged on a structure called an inflorescence. An inflorescence may support a solitary flower or display individual flowers (florets) to pollinators or expose flower parts to pollen carried on air currents.

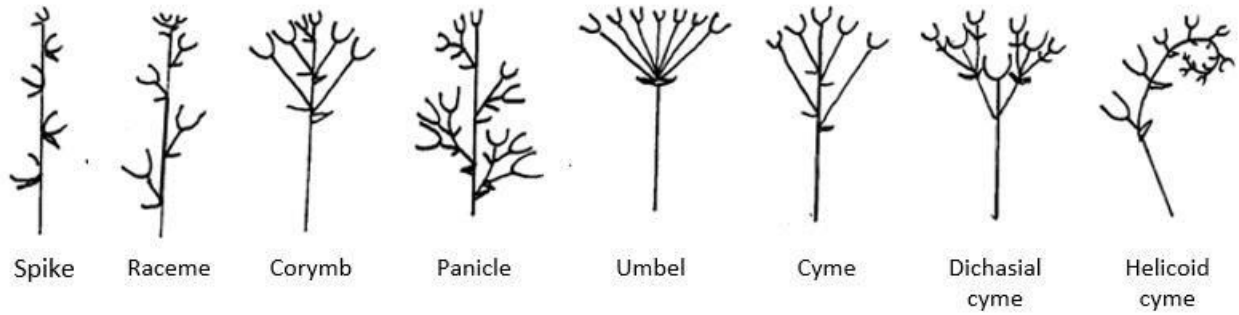

Figure 3 Inflorescence types.

Simple fruits, which form from a single, ripened ovary, may be either fleshy or dry. Fleshy fruits include the berry (grape), pepo (pumpkin), hesperidium (orange), drupe (plum), and pome (apple). Aggregate fruit develop from a single flower with numerous pistils. Once fertilized, the individual pistils develop into tiny fruitlets clustered on a single receptacle, as in a raspberry or blackberry. Multiple fruits, such as pineapples, form when numerous fertilized flowers in a single inflorescence develop together into a larger fruit.

Dry fruits, are either dehiscent (split open at maturity) or indehiscent (remain closed at maturity). Dry fruits that split at maturity include the legume (pea), silique (mustard), follicle (milkweed), and capsule (cotton). Dry fruits that do not split at maturity include the achene (sunflower), nut (pecan, almond), grain (corn), samara (ash), and schizocarp (geranium, carrot).[2]

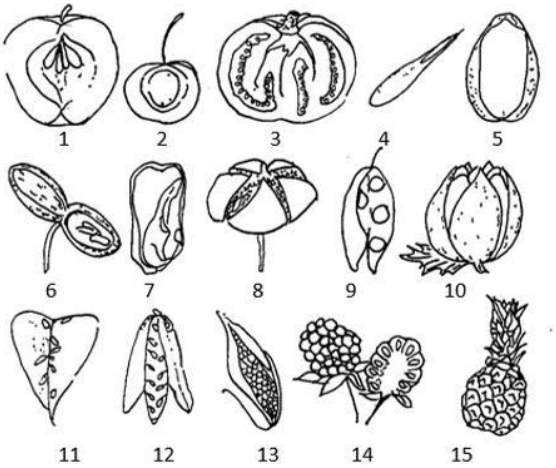

Figure 4 Fruit morphology chart.

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 5.928

| Volume 4, Issue 6, June 2021 |

II. DISCUSSION

Although most of us have a good idea what fruits and vegetables are when we eat them, it would be difficult provide a definition for someone of just what makes one food a vegetable and another a fruit. For a botanist, the definitions are easier; a fruit is a reproductive structure of an angiosperm which develops from the ovary and accessory tissue, which surrounds and protects the seed. Fruits are important in seed dispersal. A vegetable is a part of one of the vegetative organs of the plant: roots, stems or leaves, or shoot systems. There are a few "vegetables which are difficult; broccoli and cauliflower are inflorescence buds, and artichokes are the entire inflorescence. Since flowers, the reproductive organ of the plant produce fruits and seeds, perhaps those vegetables which are inflorescences are more similar to fruits than they are vegetables. No matter what we call our nutritious dietary components, in botany what constitutes a fruit is straightforward, and this lab looks at the structure and classification of fruits.

The process of fertilization initiates both seed and fruit development. While seeds develop from the ovules, the ovary tissue undergoes a series of complex changes which result in the development of the fruit. Many fruits are "fleshy" and contain sugars which attract animals who then disperse the enclosed seeds to new locations. Other, non-fleshy, fruits use other mechanisms for seed dispersal. In some plants, fruits can develop without fertilization. This is called parthenocarpy, and such fruits are seedless. As the ovary develops into a fruit, its wall often thickens and becomes differentiated into three, more or less distinct, layers. The three layers together form the pericarp, which surrounds the developing seed or seeds.[3]

The three fruit layers are:
• Exocarp, the outermost layer often consisting of only the epidermis
• Mesocarp, or middle layer, which varies in thickness
• Endocarp, which shows considerable variation from one species to another

A. Simple Fruits.
Simple fruits develop from a single matured ovary in a single flower. Accessory fruits have some other flower part united with the ovary.
1. Fleshy Fruits, pericarp fleshy at maturity
a. Berry, consisting of one or more carpels with one or more seeds, the ovary wall fleshy
(1) Pepo (an accessory fruit), a berry with a hard rind, the receptacle partially or completely enclosing the ovary
(2) Hesperidium, a specialized berry with a leathery rind
b. Drupe, a stone fruit, derived from a single carpel and containing (usually) one seed. Exocarp a thin skin
c. Pome (an accessory fruit), derived from several carpels, receptacle and outer portion. of pericarp fleshy, inner portion of pericarp papery or cartilaginous, forming a core
d. Hip (an accessory fruit), several separate carpels enclosed within the fleshy or semi-fleshy receptacle
2. Dry Fruits, pericarp dry at maturity
a. Dehiscent fruits, those which dehisce or split open when fully mature
(1) Follicle, composed of one carpel and splitting along a single suture
(2) Legume, composed of a single carpel and splitting along two sutures
(3) Capsule, composed of several carpels and opening at maturity in one of four ways:
(a) Along the line of carpel union (septicidal dehiscence)
(b) Along the middle of each carpel (loculicidal dehiscence)
(c) By pores at the top of each carpel (poricidal dehiscence)
(d) Along a circular, horizontal line (circumscissle dehiscence)
(4) Silique, composed of two carpels which separate at maturity, leaving a persistent partition between them
b. Indehiscent fruits, those which do not split open at maturity
(1) Achene or akene, a one-seeded fruit with the seed attached to the fruit at one point only
(2) Caryopsis or grain, a one-seeded fruit in which the seed is firmly attached to the fruit at all possible points
(3) Samara, a one- or two-seeded fruit with the pericarp bearing a wing like outgrowth. A modified achene
(4) Schizocarp, consisting of two carpels which at maturity separate along the midline into two one-seeded halves, each of which is indehiscent
(5) Loment, having several seeds, breaking into one-seeded segments at maturity
(6) Nut, a hard, one-seeded fruit, generally formed from a compound ovary, with the pericarp hard throughout

B. Aggregate Fruits.
Aggregate fruits consist of a number of matured ovaries formed in a single flower and arranged over the surface of a single receptacle. Individual ovaries are called fruitlets.

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 5.928

| Volume 4, Issue 6, June 2021 |

C. Multiple Fruits.
Multiple fruits consist of the matured ovaries of several to many flowers more or less united into a mass. Multiple fruits are almost invariably accessory fruits.
The Structure of Some Common Fruits
This exercise is designed to help you become familiar with the structure of several common fruit types, such as the legume, the caryopsis, the berry, the drupe, and the pome.
A. Legume: Bean or Pea
B. Caryopsis (or Grain): Corn
C. Berry: Tomato or Grape
D The Drupe: Peach (Cherries, plums, or even soaked prunes)
E. The Pome: Apple (Crab apple, pear, or quince)

III. RESULTS

Flowering plants are the most diverse group of land plants with 300,000 known species. These are also known as angiosperms and produce seed-bearing fruits. It is believed that the flowering plant evolved from gymnosperms during the Triassic period and the first flowering plant emerged 140 million years ago.
Flowers are the reproductive organs of the flowering plants and the most important feature that distinguishes them from other seed plants. These have led to the speciation of angiosperms that helps them to adapt to diverse ecological niches.
The flowering plants reproduce by the process of pollination. In this, the pollen grains transfer from the anther of the male flowers to the stigma of the female flower where fertilization occurs and seed is formed.

Root System
The root is a brown, nongreen and underground part of a plant. Root with their branches is collectively called a root system. There are three types of the root system:
Taproot System
The taproot is mainly found in dicotyledonous plants. It develops from the radicle of the germinating seed, along with its primary roots and branches, giving rise to the taproot system. Mustard seeds, mangoes, grams and banyan are a few examples of dicotyledonous plants with taproot system.
The Fibrous root System
The fibrous root is mainly found in ferns and in all monocotyledonous plants. This root develops from thin, moderately branching roots or primary roots, growing from the stem. The fibrous root system usually does not penetrate deep into the soil, therefore, on full maturity, these roots look like a mat or a carpet on the floor. Wheat, paddy, grass, carrots, onion, grass are a few examples of monocotyledonous plants with the fibrous root system.
The Adventitious root System
The roots which originate from any part of the plant body other than the radicle is called the adventitious root system. This root system is mainly found in all monocotyledonous plants. In plants, the adventitious root system is used for various purposes, like mechanical support, vegetative propagation, etc. Banyan tree, maize, oak trees, horsetails are a few examples of monocotyledonous plants with the adventitious root system.[4]
Functions of Root
General functions of a root include:
Storage.,Anchorage.,Absorption of water and minerals.,Regions of Root,The three regions of a root are-
The Root Cap.
The region of maturation.
The region of Elongation.

Shoot System
Another essential part of the plant is its stem. It is the ascending part of the plant axis which bears branches, leaves, flowers, fruits and helps in the conduction of water and minerals. It is the aerial part of the plant, developed from the plumule of an embryo or the germinating seeds.
Young stems are usually green in colour and subsequently becomes woody and brown. The stem is modified into certain structures according to the function they perform.
Characteristics of Stem
Some of the important characteristics of the stem are:
The stem develops from the plumule and epicotyl of the embryo.
The stem is erect and grows away from the soil towards the light.
There is a terminal bud at the apex of the stem.

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| Volume 4, Issue 6, June 2021 |

In angiosperms, the shoot is differentiated into nodes and internodes.
Young stems are green and photosynthetic.
Multicellular hair is present.
The stem and branches of mature plants bear fruits and flowers.
Different forms of Stem
The stem is modified into the following different forms:
Suckers.,Runners.,Climbers.,Tubers.,Rhizome.,Tendrils.,Thorns.,Cladode.

Leaves
The leaf is a laterally borne structure and usually flattened. It is the main photosynthetic part of the plants. It absorbs light and helps in the exchange of gases through the stomata.
The main parts of the leaf include the leaf base, petiole, and lamina. They grow at the node and bear a bud at the axil. The arrangement of veins and veinlets in a leaf is called venation. The leaves are green because of the presence of the photosynthetic pigment called chlorophyll and have a tiny pore or opening called stomata, where the gaseous exchange takes place.
Leaves can be further classified into simple and compound leaf, which are based on the pattern of a leaf blade. There are other types of leaves and are classified based on their shapes, arrangements of leaves, and Venation.
Characteristics of Leaves
The leaf arises from the node.,It is exogenous in origin.,It has a bud at its axis.,The growth of the leaf is limited.,The leaves do not bear an apical bud.
Modifications of Leaves
Leaves are modified according to the functions they perform. The different structural forms of leaves include:
Leaf Tendrils.,Spines.,Storage Leaves.,Insect-catching leaves.
Functions of Leaves
Some of the important functions performed by leaves are:
Photosynthesis.,Transpiration.,Storage.,Guttation.,Defence.,

Flowers
The flowers are the reproductive part of the plant. The arrangement of flowers on the floral axis is called inflorescence, which has two major parts called racemose which let the main axis continue to grow and cymose which terminates the main axis in a flow.
The flower consists of four different whorls:
Calyx, the outermost.
Corolla, composed of petals.
Androecium, composed of stamens.
Gynoecium, composed of one or more carpels.
The reproduction in plants occurs by the process of pollination. It is the process of transfer of pollen from the anther to the stigma of the same or different plants.
Functions of Flowers
The flower performs the following important functions:
They help in the process of reproduction.
They produce diaspores without fertilization.
The gametophytes develop inside the flower.
The flowers attract insects and birds which then act as a medium to transfer the pollen from the anther of one flower to the stigma of some other flower.
The ovary of the flower develops into a fruit that contains seed.

Fruits
The fruit is the characteristic feature of flowering plants, which is a ripened or mature ovary and the seed is what the ovules develop into after fertilization. The fruit that develops without fertilization is known as parthenocarpic.
Types of Fruits
There are three different types of fruits and are classified mainly based on their mode of development.
Simple— Developed from the monocarpellary ovary or multicarpellary syncarpous ovary. Examples of simple fruits.
Aggregate–Developed from the multicarpellary apocarpous ovary. Examples of aggregate fruits.
Composite–These are false fruits, developed from the entire inflorescence rather than from single flower. Examples of composite fruits include blackberries, Raspberries strawberries, etc.

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 5.928

| Volume 4, Issue 6, June 2021 |

The Seed

A seed is a basic part of a plant, which is found enclosed within the fruit. It is made up of a seed coat and an embryo. During the development of the fruit, the wall of the ovary becomes the pericarp. In some plants, the ovary wall dries out completely, while in some it remains fleshy.

Types of Seeds

Based on the number of cotyledons, seeds are further classified into two types- dicotyledonous and monocotyledonous seeds.

Monocotyledonous— The embryo consists of an embryo axis and has only one cotyledon. The monocotyledonous is also known as monocot seeds. Grains including rice, millet, wheat and other plants like onions, corn, ginger banana, palm tree, are examples of monocot seeds.

Dicotyledonous— The embryo consists of an embryo axis and has two cotyledons. The dicotyledons are also known as dicots or dicot seeds. Legumes including beans, lentils, pea, peanuts, and tomato are examples of dicot seeds.

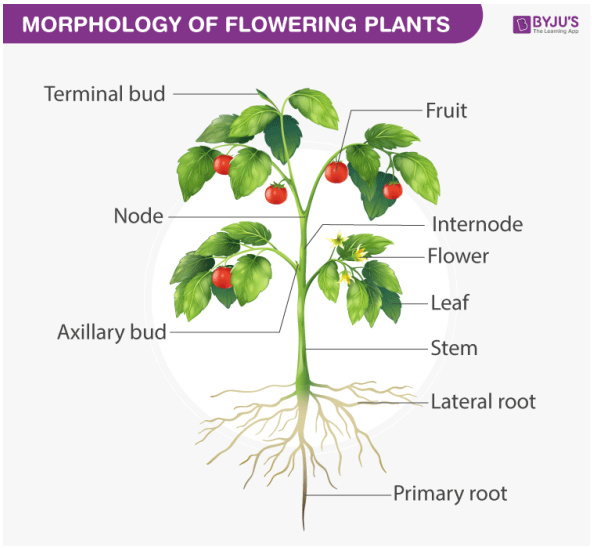

Figure 5: complete angiosperm

IV. CONCLUSION

Flowering plants exhibit enormous variation in shape, size, structure, mode of nutrition, life span, habit and habitat. They have well developed root and shoot systems. Root system is either tap root or fibrous. Generally, dicotyledonous plants have tap roots while monocotyledonous plants have fibrous roots. The roots in some plants get modified for storage of food, mechanical support and respiration. The shoot system is differentiated into stem, leaves, flowers and fruits. The morphological features of stems like the presence of nodes and internodes, multicellular hair and positively phototropic nature help to differentiate the stems from roots. Stems also get modified to perform diverse functions such as storage of food, vegetative propagation and protection under different conditions. Leaf is a lateral outgrowth of stem developed exogeneously at the node. These are green in colour to perform the function of photosynthesis. Leaves exhibit marked variations in their shape, size, margin, apex and extent of incisions of leaf blade (lamina). Like other parts of plants, the leaves also get modified into other structures such as tendrils, spines for climbing and protection respectively. The flower is a modified shoot, meant for sexual reproduction. The flowers are arranged in different types of inflorescences. They exhibit enormous variation in structure, symmetry, position of ovary in relation to other parts, arrangement of petals, sepals, ovules etc. After fertilisation, the ovary is converted into fruits and ovules into seeds. Seeds either may be monocotyledonous or dicotyledonous. They vary in shape, size and period of viability. The floral characteristics form the basis of classification and identification of flowering plants. This can be illustrated through semitechnical descriptions of families. Hence, a flowering plant is described in a definite sequence by using scientific terms. The floral features are represented in the summarised form as floral diagrams and floral formula[5]

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