LECTURE: 3 HORTICULTURAL AND BOTANICAL CLASSIFICATIONS

From time to time, horticultural crops have been classified into various groups depending on their growth habits, cultivation requirements, climatic needs and uses. Horticultural crops are popularly classified into the **5 broad divisions of fruits, vegetables and flowers, plantation crops, aromatic and medicinal plants.** The classification of horticultural crops are as follows-

1. Classification of Horticultural Crops Based on Growth Habit and Physiological Character

Herbs: Ageratum, Lawn Grasses.

Shrubs: Nerium, Hibiscus,

Trees: Mango, Tamarind, Rain tree

Climbers: Bougainvillea

Creepers: Bignonia, gracillis.

2. Classification of Horticultural Crop Based on Life Span of Plants

I) Annuals:

From the name it is clear that the plants live for one season or less. Annual plant is one which completed its life cycle from germination to seed formation within one season and then dies usually as a result of complete exhaustion of its food reserve in the process of reproduction. Mostly they complete their life history in 3 to 6 months. They comprise of several of most beautiful and easily grown plants, widely varying in from habit of growth and colour. Annuals are very effective, grown neither in pots nor in ground. Particular annuals thrive best in particular period of the year. The annuals are conveniently grouped according to season as follows.

1. Rainy Season Annuals:

The time of sowing then would be from April to May in most places **e.g. Marygold, Aster, Salvia, Zinnia etc.**

2. Winter or Cold Season Annuals:

These are sown in September, October e.g. **Phlox, Antirrithium.**

3. Hot weather or summer season Annuals:

They are sown in January - February and blooming period is April, May e.g. **Sunflower, Gailardia, and Zinnia.**

II) Biennials:

These plants usually requires two years or at least two growing seasons with more or less of a dormant season or lasting season between two completed life cycle. Seed sown in spring or

summer, and vegetative growth is completed in first year and in the following spring, flowering and fruiting takes place. Generally the period of growth is 6 to 9 months e.g. Gladioli, Dahlia. No hard and fast line can be drawn between annuals and biennials crops like **turnip, carrot, cabbage and onion are classified as biennials.**

III) Perennials:

Any plant that lives more than two years is a perennial e.g. **Mango, Citrus. These crops are classified in to two groups.**

i) Herbaceous:

Herbaceous perennials are those with more or less soft succulent stems.

a) Trees b) Shrubs c) Vines according to their habit of growth.

a) Trees:

Trees are upright in habit and stems take the form of central axis e.g. **Mango, Sapota, guava, Mandarins etc.**

b) Shrubs:

Shrubs have no main trunk but a number of erect or semi erect stems are seen but do not forms the main frame work e.g. **Hibiscus, Rose, and Lantana Acalyphya etc**.

c) Vine:

Both woody and herbaceous have stems which are flexible and not in position to keep their branches and leaves erect. e.g. **cucurbit vines, Grape vines, Passion fruit etc.**

3. Classification of Horticultural Crops Based on continuation growth

i) Deciduous: Talling off or shed seasonally or as a certain stage of development in the life cycle. Fig., Guava, Apple, pear, peach, plum, Ber, Sweet cherry, Pomegranate, Grape, Mulberry, Phalsa and Almond

ii) Evergreen: Evergreen is a plant which has foliage that remain green and functionl through more than one growing season.

e.g. Mango, citrus, litchi, sapota, Aracanut, Dates, Coconut, Pineapple, Banana, Jackfruit, Avocado, Sweet orange,Mandarin orange, K. lime, Chicku, Papaya, Passion fruit, Cashew nut

4. Classification of Horticultural Crops Based on Climatic Requirements (Particularly Temperature)

Based on temperature requirements and response to different climatic conditions, horticultural crops have been classified in to three main groups and these are :

i) Temperate:

Temperate plants are commonly found in cold regions enjoying a mild and temperate climate. These plants endure cold and go to rest or dormancy by shedding of all their leaves during winter. Bellow freezing point in winter there is snowfall in the types of climate. The ground remain coverd

with snow 3 to 5 months in a year. During in summer the temperature found that varies 10^0 C - 14^0 C and RH 80 to 100 per cent. This types climate observed that 1800m to 3500m hight from ground level.

e.g. Apple, Peach, Pear, Plums, cherry, walnut, celery, apricot, and almond etc.
Vegetables- Pea, beans, cole crop,root crop, globe artichoke, aspergus,
Flower- Rose, gladiolus, orchids, marigold

ii) Tropical:

There is no distinct summer and winter in this types of climate. Hot and humid summer and mild winter is hallmark of tropical climate. There is no much fluctuation in day and night temperature.

High rainfall with high humidity.

Temperature range- 22 ^{0}C to 27 ^{0}C

Hight 300m to 900 m from ground level

Tropical plants are those which do not tolerate severe cold but can tolerate warm temperatures of about 9000F. Those plants need strong sunshine, warms, humidity and a very mild winter. They cannot stand far against frost e.g. Fruits-Papaya, Banana and Pineapple, Mango, Jackfruit, Vegetables-Onion, chilli, tomato. Tapioca, sweet potato, elephant foot's yam, ginger, pumpkin

Flowers- Tuberose, Jasmine.

iii) Sub - Tropical:

They need warmth and humidity and can tolerate mild winters.

Hot and dry summer less severe winter are the characteristics of **sub-tropical climate**. These fluctuation in day and night temperature is high and less. Tem. 25^0C - 30^0C, RH 100 per cent during monsoon. E.g. Fruit- Pomegranate, Guava, Citrus, fig, Phalasa

Vegetables- Pea, beans, cucurbits, tomato and brinjal etc.

Sub - tropical plants like Orange, Litchi, Fig, Mango and cashew nut are intermediate in character.

This does not necessarily mean that a plant belonging to one zone does not grow in other zones. For instances, annual crops of the temperate region like potato, knolknol and cabbage grow in tropical and sub - tropical regions also, but they come up well only in the winter season than other climatic zones.

5. Classification of Horticultural Crops Based on Season

Horticultural crops are also classified according to the season in which they grow best. In our country we have three main season.

i) The Summer season, which starts from March and lasts upto May.

ii) The rainy season from June to October and

iii) The winter season from November to February.

Rainy season crops are known as "Kharif" crops. These crops come up best when sown with the onset of **monsoon in May, June.** Vegetables like Snake gourd, Lady's finger, Chilies and Beans comes under the category.

Lupines are known as "Rabi crops". They are generally **sown October, November**.

Only a few annual crops thrive in the warm summer months between March and June in the plains. Leafy vegetables, cluster beans, Brinjal, Cucumber, and Gourds are the common summer vegetables. The popular summer season Sunflowers, Cooks comb, Rose, Zinnia etc. There are some vegetables like tomato, brinjal, beans and flowers like which grow all the year count, but they come up best when there is optimum season.

The yield of a crop is also dependent upon the time of sowing. Crops which are sown under rain fed conditions are entirely dependent on rain fed conditions for their survival and growth and therefore, have to be sown just at the right time.

6. Classification based on types of fruit:

Fruit morphology:

1) Simple fruit - Berry: Banana, Papaya, Grape, Sapota, and Avocado

2) Modified berry-

i. **Balusta** : Pomegranate

ii. **Amphisarca** : Woodapple, Bael

iii. **Pepo** : Water melon

iv. **Pome** : Apple, Pear, Laquat

v. **Drupe (Stone**) : Mango, Pear, Plum

vi. **Hesperidium** : Citrus

vii. **Nut** : Cashew, Litchi, Walnut, Rambutan

viii. **Capsule** : Anola, Carambola

3) Aggregate fruits : Etario of berries –Custard apple, Raspberry

4) Multiple fruit : Syconus- Fig **: Sorosis-** Jackfruit, Pineapple, Mulberry

True fruit: It is a mature or ripened ovary, developed after fertilization, e.g., Mango, Grape

False Fruits: A false fruit or **pseudo-carp** is derived from the floral parts other than ovary, e.g., peduncle in cashew-nut, thalamus in apple, pear, gourd and cucumber; fused perianth in mulberry and calyx in Dillenia.

Jack fruit and pine apple are also false fruits as they develop from the entire inflorescence. False fruits are also called spurious or accessory fruits.

Morphology of a Typical Fruit:

A fruit consists of pericarp and seeds. Seeds are fertilized and ripened ovules. The pericarp develops from the ovary wall and may be dry or fleshy. When fleshy, pericarp is differentiated into outer epicarp, middle mesocarp and inner endocarp.

Types of Fruits:

On the basis of the above mentioned features, fruits are usually classified into three main groups:

(1) Simple,
(2) Aggregate and
(3) Composite or Multiple fruits

Simple Fruits:

When a single fruit develops from a single ovary of a single flower, it is called a simple fruit. There are two categories of simple fruits—dry and fleshy.

1. Dry Fruits:

These fruits are not fleshy, and their pericarp (fruit wall) is not distinguished into three layers.

Nut: The pericarp is harder and leathery or woody. It may develop from a simple or compound pistil with superior or inferior, uniovuled ovary. Eg- Litchi and Cashew nut .In case of Litchi pericarp is hard and leathery. The edible part is aril which is an outgrowth of seed from the micropylar end and becomes juicy

2. Succulent Fruits (Fleshy fruits):

In these fruits pericarp is distinguished into epicarp, mesocarp and endocarp. Mesocarp is fleshy or fibrous. These fruits are indehiscent, and seeds are liberated after the decay of the flesh. It is of 3 types – drupe, pome and berrie

Drupe:

The pericarp or fruit wall is differentiated into thin epicarp (skin) fleshy mesocarp and stony endocarp. Hence it is also called as stone fruit, e.g., Mango, Coconut, Peach, Almond. In mango, mesocarp is juicy and edible. In coconut mesocarp is fibrous and edible part is endocarp. In almond, epicarp and mesocarp get peeled off and only hard endocarp can be seen in marketed fruits. The edible part is cotyledons.

Pome:

It is a simple, fleshy but false fruit as it is surrounded by a fleshy thalamus which is edible while actual fruit lies within, e.g., apple, pear, loquat etc

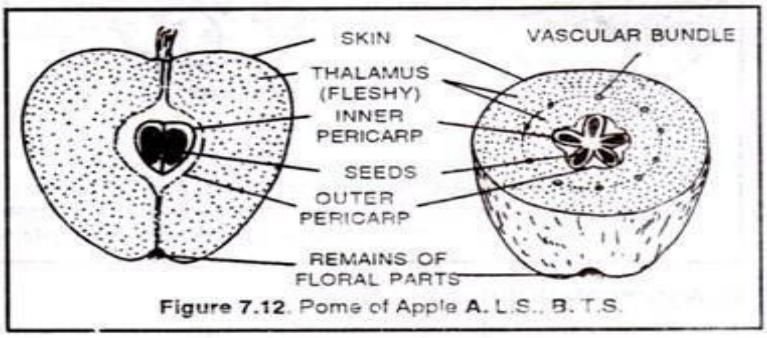


Figure 7.12. Pome of Apple **A.** L.S., **B.** T.S.

Berry: Berry is a fleshy or pulpy indehiscent fruit in which the entire ovary wall ripens into a relatively soft pericarp and the seeds are embedded in the common flesh of the ovary, and typically there is more than one seed which generally gets detached from the placenta.
Examples of botanical berries include the tomato, grape, avocado, and persimmon.

There are some fruits which show variations from the normal berry:

(i) Pepo:

This develops from inferior ovary which is unilocular or falsely trilocular having parietal placentation. The seeds remain attached to placenta. The outer ring is very hard as in Cucurbits (Fig. 7.13D).

(ii) Hesperidium:

It develops from polycarpellary, syncarpous, superior, multilocuiar ovary with axile placentation. Epicarp forms the leathery peeling, mesocarp is in the form of fibres while the endocarp projects inwards forming distinct chambers from which juicy ingrowths in the form of hair arise which form the edible part, eg. Citrus (Orange, Lemon) (Fig. 7.13E).

(iii) Amphisarca:

It is derived from polycarpellary, syncarpous, multilocuiar and superior ovary. In this case, epicarp is woody. The placenta and inner layers of pericarp become pulpy and edible in which the seeds are scattered. The testa is muclilagenous, e.g., Aegle marmelose (Fig. 7.13-1).

(iv) Balusta:

It is a berry with an outer hard rind formed of epicarp and a part of mesocarp. The inward foldings of mesocarp form chambers. Each chamber is lined by papery endocarp which encloses a group of seeds. The seeds are covered by edible juicy testa. e.g., Pomranate (Fig. 7.13-G).

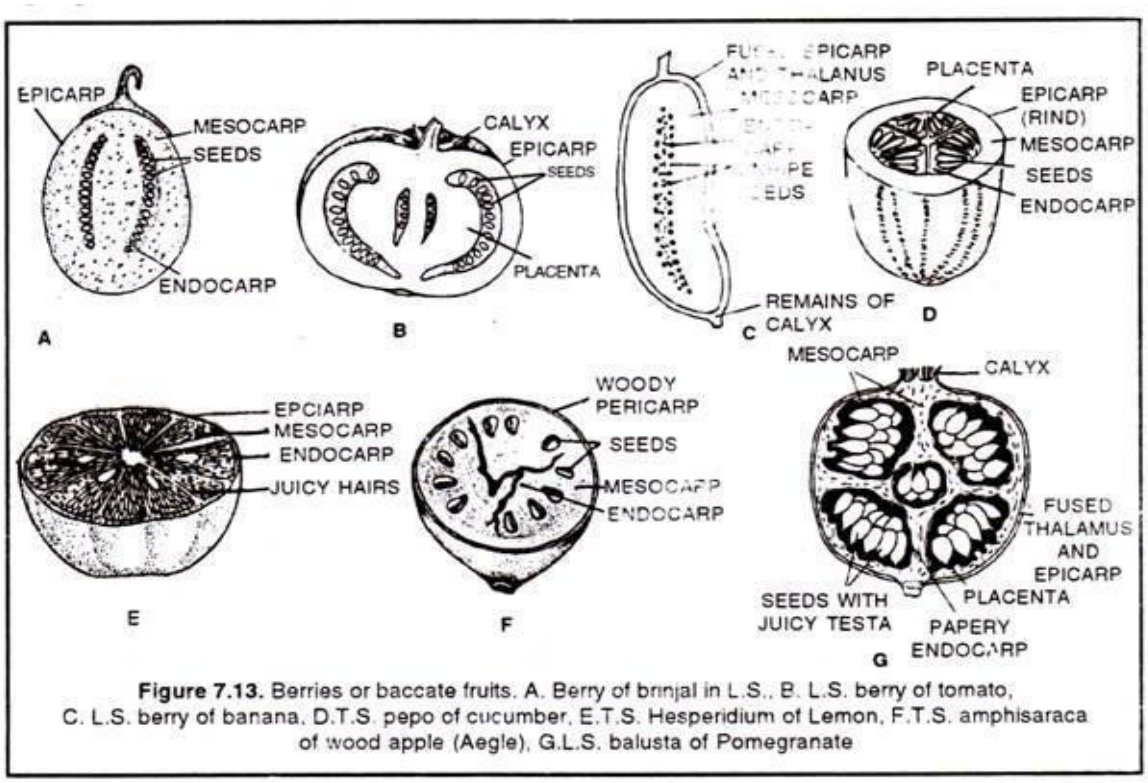


Figure 7.13. Berries or baccate fruits. A. Berry of brinjal in L.S., B. L.S. berry of tomato, C. L.S. berry of banana, D.T.S. pepo of cucumber, E.T.S. Hesperidium of Lemon, F.T.S. amphisaraca of wood apple (Aegle), G.L.S. balusta of Pomegranate

II. Aggregate Fruits:

Flowers with polycarpellary and apocarpous gynoecium give rise to a number of fruitlets as there are a number of free ovaries, each giving rise to one fruitlet. Sometimes, these fruitlets coalesce together appearing to be a single fruit but in many other cases, the fruitlets remain free from one another forming etaerio of fruitlets. An aggregate fruit is named according to the nature of fruitlets.

1. Etaerio of achenes:

Aggregate of achenes are found in Fragaria (strawberry), Rose, Ranunculus, Nelumbium (lotus) etc. Here each fruitlet is an achene; and achenes are hairy. In rose (Rosa), many achenes are present on a saucer (cup) – shaped thalamus. In lotus (Nelumbium), thalamus becomes spongy and some achenes are embedded in it. In strawberry [Fragaria), the thalamus is fleshy and becomes red on maturation and is the edible part (Fig. 7.14).

2. Etaerio of berries:

In *Anona squomosa* (Custard apple) the berries become very fleshy and being crowded together on a thick thalamus form a complex single fruit (Fig. 7.17). The apices of berries fuse together forming something like a common rind.

3. Etaerio of drupes:

It is an aggregate of small drupes or drupelets developing from different carpels of a flower, and arranged collectively on fleshy thalamus, e.g. *Rubus idaeus.*

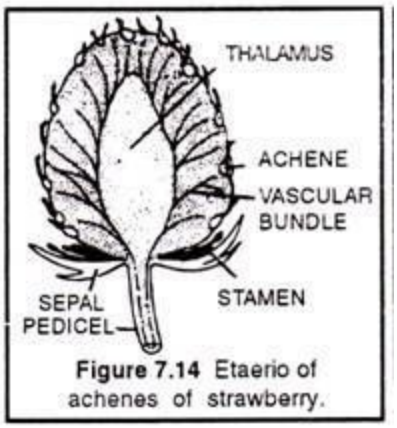


Figure 7.14 Etaerio of achenes of strawberry.

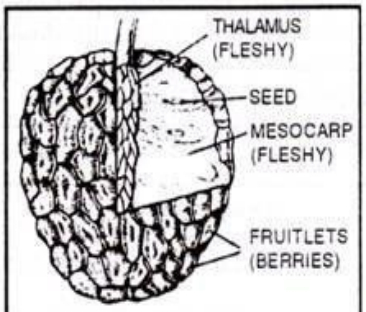


Figure 7.17 Etaerio of berries of custard apple.

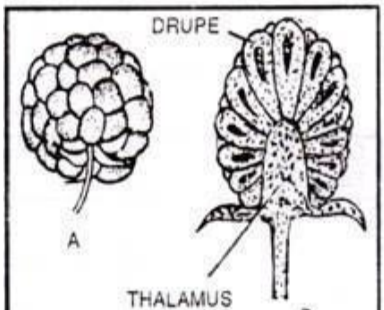


Figure 7.18 A. Etaerio of drupes of *Rubus* (Raspberry). B. Section of the same.

III. Composite Fruits:

A fruit developing from a complete inflorescence is called a multiple or a composite fruit.

There are two main types of composite fruits:

1. Sorosis:

This type of fruit is found in Mulberry, Pineapple and Jack fruit (kathal). These fruits are derived from catkin, spike and spadix type of inflorescence (Fig. 7.19).

Mulberry (Morus indica) fruit develops from catkin in which fleshy perianth encloses dry achenes.

In jack fruit, thick club-shaped peduncle has the flowers arranged on it. The fertile fruits have juicy, edible perianth lobes and the bracts form more or less juicy chaffs around them. The spines on the tough rind represent the stigmas of the carpels. Each seed is covered by a membranous testa. In Pineapple (Ananas sativus), the ovaries are not so conspicuous, edible portion being formed by peduncle, perianth and bracts. Each polygonal area on the surface represents a flower. This fruit develops from an intercalary spike.

2. Syconus:

This fruit develops from the hypanthodium type of inflorescence and is characteristic of Ficus. In fig, Banyan etc. (Fig. 7.21) female flowers within the closed receptacle (which becomes fleshy) of the inflorescence develop into achenes giving rise to a multiple fruit of achenes.

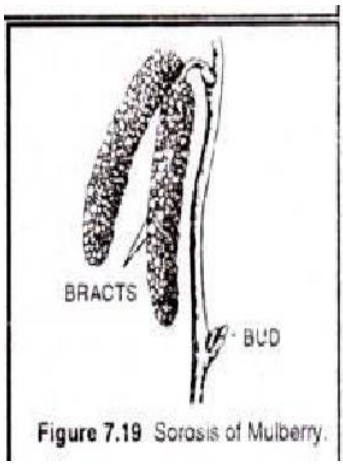


Figure 7.19 Sorosis of Mulberry.

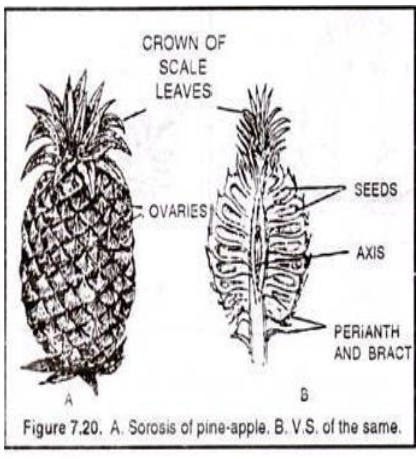


Figure 7.20. A. Sorosis of pine-apple. B. V.S. of the same.

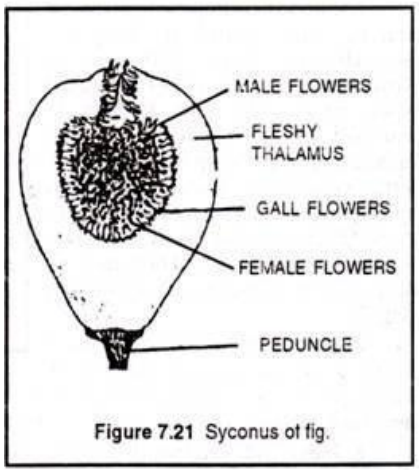


Figure 7.21 Syconus of fig.

7. Based on ripening behaviour or rate of respiration

Climacteric Fruits Climate fruit have capacity to continue ripening once separated from the plants. Ethylene production is very high and rate of respiration is more	**Non-climacteric Fruits** Non- climacteric fruits once harvested do no ripen further they produce very small amount of ethylene and do not respond to ethylene treatment on fruit.
Mango, Banana, Sapota, Guava, Papaya, Apple, Fig, Peach, Pear, Plum, Annona, Tomato	Citrus, Grape, Pomegranate Pineapple Litchi, Ber, Jamun, Cashew, Cucumber, Cherry, Strawberry.

8. Based on photoperiodic requirements

Long day (12hrs or more)	**Short day (12hrs or less)**	**Day-neutral plant**
Passion fruit, Banana, Apple	Strawberry, Pineapple, Coffee	Papaya, Guava

9. Based on longevity:

a) Very Long longevity - >100yrs- Datepalm, Coconut, Arecanut
b) Long longevity - 50-100yrs - Mango, Tamarind
c) Medium - 10-50yrs - Litchi, Guava,Pomogranate
d) Short - Pineapple, Banana

10.Based on consumers preference or weight of fruits

a) Very light - 50-100gm Grape, Ber, Banana

b) Light - 100-150gm Sapota,Pomegranate

c) Light medium - 150-300gm Mango

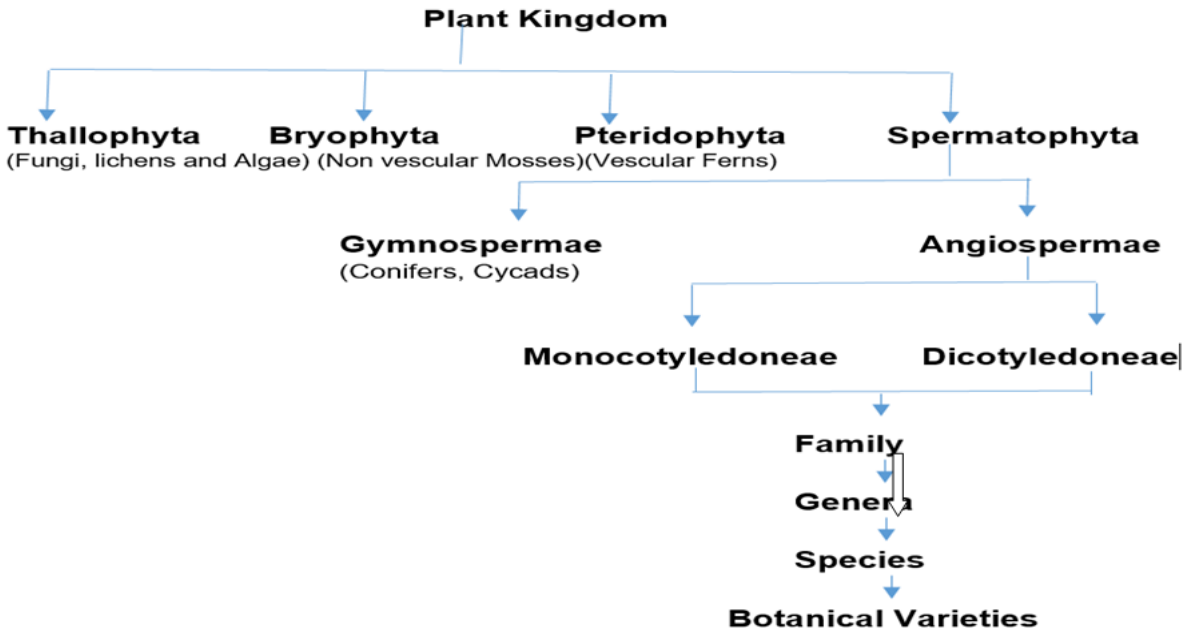
d) Medium - 300-350gm Avocado

e) Medium to heavy - 800-1000gm Mango

f) Heavy - 1-5kg Bread fruit, Pineapple

g) Very heavy - >5kg Jack Fruit

11. Botanical classification based on botanical relationship with genomes:



Description-

Thallophyta: Thallus- undifferentiated, some time- Mixomycota/Bacteria and also known as cryptogam, most of them aquatic (Fungi, Algae, Lichen)

Bryophyta : It is the major class of plant kingdom absence of vascular tissue (Non-vascular Mosses), hornworts, liverworts, Marchantia thallus.

Peteridophyta : (Vascular ferns): it is a vascular plant (xylem-phloem), that disperses spores because peteridophyta produces neither flower nor seed.

Spermatophyte: seed-bearing plants

Gymnosperms: it is a group of seed-producing plants that includes conifers, and cycads. Or Among these, instead of being closed in flowers and fruits there are small twigs or cones which are open.

Angiospermae: big group, fully developed, divided in two group in divided i) Monocotyledoneae and ii) dicotyledoneae

Sr. No.	Comman name	Botanical name	Family
Monocotyledanae			
1	Banana	*Musa paradisiaca*	Musaceae
2	Pineapple	*Ananas comusus*	Bromeliaceae
3	Date palm	*Phoenix dactylifera*	Palmae
Dicotyledanae			
4	Mango	*Mangifera indica*	Anacardiaceae
5	Pistachionut	*Pistachia vera*	Anacardiaceae
6	Cashew	*Anacardium occidentalle*	Anacardiaceae
7	Custard apple	*Annona squamosa*	Annonaceae
8	Karonda	*Carissa carandus*	Apocyanaceae
9	Kiwi fruit	*Actinidia chinensis*	Actinidaceae
10	Guava	*Pisidium guajava*	Myrtaceae
11	Jack fruit	*Atrocarpus heterophyllus*	Moraceae
12	Fig	*Ficus carica*	Moraceae
13	Papaya	*Carica papaya*	Caricaceae
14	Aonla	*Emblica officinalis*	Euphorbiaceae
15	Mongosteen	*Garcinia mangostana*	Guttiferae
16	Avacado	*Perisa americana*	Lauraceae
17	Tamarind	*Tamarindus indica*	Leguminosae
18	Guava	*Psidium guajava*	Myrtaceae
19	Jamun	*Syzygium cumini*	Myrtaceae
20	Passion fruit	*Passiflora edulis*	Passifloraceae
21	Pomegranate	*Punica granatum*	Punicaceae
22	Ber	*Ziziphus jujuba*	Rhamnaceae
23	Loquat	*Eriobotrya japonica*	Rosaceae
24	Kagzi lime	*Citrus aurantifolia*	Rutaceae
25	Sweet orange	*Citrus sinensis*	Rutaceae
26	Mandarin	*Citrus reticulata*	Rutaceae
27	Rough lemon	*Citrus jambheri*	Rutaceae
28	Lemon	*Citrus limon*	Rutaceae
29	Bael	*Aegle marmelos*	Rutaceae
30	Wood apple	*Feronia limonica*	Rutaceae
31	Litchi	*Litchi chinensis*	Sapindaceae
32	Sapota	*(Achras zapota) Manilkara*	Sapotaceae
33	Phalsa	*Grewia subenaequalis*	Tiliaceae
34	Grape	*Vitis vinifera*	Vitaceae
35	Apple	*Malus domestica*	Rosaceae

Botanical classification of vegetables

a) Moncot

i. Araceae – Colocasia
ii. Alliaceae- Onion, Garlic
iii. Dioscoreaceae- Yam

b) Dicot

i. Chenopodiaceae Spinach
ii. Crucifere-Cole Crops, Turnip, Radish
iii. Leguminoceae: - Pea, beans, Fenugreek
iv. Euphorbiaceae-Tapioca
v. Malvaceae: - Okra
vi. Umbelliferae: - Carrot
vii. Convolvulaceae: - Sweet Potato
viii. Solanaceae: - Tomato, Brinjal, Chilli, Potato
ix. Cucurbitaceae: - Gourds, Melons, Pumpkin
x. Compositae:- Lettuce

12. Classification on the basis of plant part used forconsumption

a) Fruits

Sr. no	Name of fruits/Examples	Type of fruit	Edible parts
1	Apple	Pome	Fleshy thalamus
2	Pomegranate	Pome	Aril
3	Banana	Berry	Meso carp and endocarp
4	Grape	Berry	Pericarp and placenta
5	Guava	Berry	Thalamus and pericarp
6	Papaya	Berry	Mesocarp
7	Cashew nut	Nut	Peduncle and cotyledon
8	Coconut	Fibrous drupe	Endosperm
9	Custard apple	Etario of berries	Fleshy pericarp of individual berries
10	Fig	Syconus	Flashy receptacle
11	Mango	Drupe	Meso carp
12	Orange	Hesperidium	Juicy placental hair
13	Pineapple	sorosis	Fleshy thalamus

b) Vegetables

Sr. no	Name of vegetables	Edible parts
1	Raddish, carrot, turnip, sweet potato	Roots
2	Knolkhol, potato,	Stem
3	Palak, methi, amranthus	Leaf
4	Cauliflower, broccoli	Flower

5	Tomato, brinjal, okra, cucurbits	Fruits
6	Beans and Pea	Pod
7	Onion	Bulb

c) Plantation crops and spices

Sr. no	Name of fruits	Edible parts
1	Coconut (fibrous drupe)	Endosperm
2	Arecanut(One seeded drupe)	Seed(Fresh and dried)
3	Cocoa (5- ribbed drupe)	Beans(seed)
4	Coffee (fleshy drupe)	Seed (beans)
5	Black pepper (one seeded spherical drupe)	Dried wrinkled fruit
6	Clove (Fleshy drupe)	Unopened flower bud
7	Cinnamon (fleshy drupe)	Bark
8	Chilli(Berry)	Fruit with seed
9	Turmeric	Rhizome
10	Ginger(Capsule)	Rhizome
11	Onion	Leaves and bulb
12	Garlic	clove

13.Based on bearing behaviour

Bearing behaviour	Terminal bearing	Axillary bearing	Mixed bearing
Bearing on new growth	Loquat, jackfruit, bael, pecannut	Guava, aonla, sapota,karonda, fig, phalsa, ber	Kamrakh, Pomegranate, Citrus
Bearing on old growth	Mango, litchi	Apple, peach, pear, plum,tamarind	