TEACHING MATERIAL ON

Fundamental of Horticulture

Dr. Abha Nutan Kujur

School of Agricultural Science
YBN University, Ranchi, Jharkhand-834010

Lecture 1: DEFINITION, DIVISION OF HORTICULTURE

The term **Horticulture** is derived from two Latin words i.e. **Hortus** meaning garden or enclosure and **Cultra** meaning cultivation. So, horticulture literally means garden culture or culture of garden.

Modern horticulture may be defined as a part of agricultural science, which deals with the production, utilization, and improvement of fruits, vegetables, flowers, ornamentals, plantation crops, medicinal and aromatic plants etc.

DIVISIONS OF HORTICULTURE

Horticulture crops include fruits, Vegetables, flowers, plantation crops, Spices, condiments, Medicinal and Aromatic crops etc. In addition to these, Horticulture also deals with raising of trees for shade, ornamental and avenue purposes, planning and raising of ornamental gardens, parks and raising of seed and planting material. Further, horticulture also deals with the utilization of horticulture produce and improvement of horticulture crops.

Hence, based upon the crops dealt and also their purpose and utilization, the branch of horticulture is sub-divided in to the following divisions for convenience.

- **Pomology:** It is derived from two words i.e. Pomum meaning fruit and Logos meaning discourse or study. So, pomology is study or cultivation of fruit crops. E.g. Mango, Sapota, Guava, Grape, Banana etc.
- **Fruit:** It is a developed and matured ovary with or without accessory parts and which is generally eaten as raw.
- **Olericulture**: It is derived from two words ie. Oleris meaning Potherb and Cultra meaning cultivation. So, Olericulture literally means potherb cultivation. In the present days it is broadly used to indicate the cultivation of vegetables. Eg. Brinjal, Okra, Tomato, Pumpkin etc.
- **Vegetable**: It is any part of the herbaceous plant that is generally used after cooking as a principal part of the meal.
- **Floriculture:** It is derived from two words i.e. Florus meaning flower and Cultra meaning cultivation. So floriculture means study of flower crops.
  In this there are again two sub-divisions. (1) Commercial Floriculture (2) Ornamental Floriculture.

  Commercial floriculture:Deals with the cultivation of flower crops grown on commercial scale for profit (Income). E.g.: Rose, Jasmine, Carnation, Aster, and Marigold etc.

  Ornamental floriculture:It deals with the raising of flower crops for ornamental, pleasure and fashion purposes. E.g.: Dahlia, Zinnia, Cosmos, Hibiscus, Balsam, Nerium, Poinsettia, Hollyhock, Gerbera, and Gaillardia etc.

- **Arboriculture:** This branch deals with the raising of perennial trees meant for shade, avenue or ornamental purposes. Eg.Polyalthia, Spathodea, Cassia, Gulmohar etc.

- **Plantation crops**: Are those crops, which are cultivated in an extensive scale in large contiguous areas, owned and managed by an individual or a company and whose produce is utilized only after processing.Eg. Coffee, Tea, Rubber, Coconut, Cocoa etc.
- **Spices and condiments:** This branch deals with the cultivation of crops whose produce is used mainly for seasoning and flavouring dishes.

  Spices:Are those plants the products of which are made use of as food adjuncts to add aroma and flavour. Eg. Pepper, Cardamom, Clove, Cinnamon, All spice etc.

  Condiments:Are those plants the products of which are made use of as food adjuncts to add taste only. Eg.Turmeric,Ginger,Red chillies,Onion,Garlic etc.

  Both spices and condiments contain essential oils, which provide aroma, flavour and taste and they are of little nutritive value.

- **Medicinal and aromatic plants**: It deals with the cultivation of medicinal plants, which provide drugs and aromatic crops which yields aromatic (essential) oils.
- ***Medicinal plants-*** are those plants, which are rich in secondary metabolites and are potential sources of drugs. The secondary metabolites include alkaloids, glycosides, coumarins, flavonoides and steroids etc.

  Eg. Periwinkle, Opium, Menthi, Cinchona, Dioscorea Yam, Belladona, Senna, Sarpagandha, Aswagandha, Tulasi etc.

- ***Aromatic plants-*** are those plants, which possesses essential oils in them. The essential oils are the odoriferous steam volatile constituents of aromatic plants. Eg. Lemon grass, Citronella, Palmrosa, Vetiver, Geranium, Davanam, Lavendor etc.

Lecture 2: IMPORTANCE AND SCOPE OF HORTICULTURE

The horticulture sector contributes about 30.4 per cent of the agriculture GDP, besides providing employment for 19 per cent of the labour force. The demand for horticulture produce is expected to increase owing to increasing urbanization, income-lead higher standard of living, enhanced awareness of nutrition security and family welfare programmes.

A. IMPORTANCE OF HORTICULTURAL CROPS IN HUMAN NUTRITION

From human nutrition point of view horticulture is most important to our daily living. Many of the horticulture crops and their products find place in our meals and diet. Human body requires vitamins, minerals, proteins, energy etc. for its health. All these are supplied by horticultural crops. Fruits and vegetables are the chief sources of vitamins, minerals, carbohydrates, fats, proteins etc. Fruits and vegetables are recognized as protective foods as they are necessary for the maintenance of human health.

The Role of Horticulture in Alleviating Nutritional Deficiencies in the Developing World

Malnutrition is the condition that occurs when your body does not get enough nutrients.

Fruits: The Simple Solution

Vitamins: These are the important constituents of fruits and are indispensable part of human diet. Although required in very minute quantities, they are absolutely essential for the maintenance of health. The deficiency of any vitamin from the diet for considerable period may lead to diseased state or disorder conditions. Fruits supply several vitamins

- **Vitamin-A:** Sources-Mango, Papaya, Dates, Jackfruit, Walnut etc.
- **Vitamin B1 (Thiamine):**. Sources - Orange, pineapple, jack fruit, cashew nut, walnut, dry apricot, almond, banana etc,.
- **Vitamin B2 (Riboflavin):** Sources - Bael, papaya, litchi, banana, apricot, pomegranate, pear etc.
- **Vitamin -C (Ascorbic Acid):** Sources - Amla, guava, ber, citrus, strawberry, pineapple etc.
- **Calcium:** Sources - Acid lime, Orange, Fig, Dried apricots, wood apple etc.
- **Iron:** Sources - Custard apple, Guava, Pineapple, Straw berry, Grape, Black currents, dried dates etc.
- **Phosphorous:** Sources - Guava, Grape, Jackfruit, Passion fruit, Orange
- **Proteins:** Sources: Fruits- Guava and Banana. Nut fruits like Walnut, Cashew nut and almond etc supplies proteins besides energy.
- **Enzymes:** Sources: Papaya-Papain and Pineapple-Bromelin.

B. COMPARISON OF HORTICULTURE WITH OTHER AGRICULTURAL SECTORS

1. **Per Unit Area Yield is High:** As compared to the field crops per hectare yield of horticulture

crops is very high. From an fruit area of land more yield is obtained e.g. paddy gives a maximum yield of only 30 q/ha, while Banana gives 300 to 500 q/ha, Pine apple 450 q/ha and Grapes 90 - 150 q/ha. In present shortage of food and scarcity of land by growing fruits more food can be produced.

2. High Returns per Unit Area: From one unit area of land more income will be obtained e.g. Well kept orchard of apple, grapes and sweet orange can give as much as Rs. 25,0000 per ha as net income.

3. A Free Grower/Labour Remains Engaged for the Whole: An opportunity for maintaining labours throughout the year like the cereals where one cannot keep himself and employ the labours during the slack season.

4. Best Utilization of Waste Land:

Some fruit crops can offer best utilization of waste land crops like wood apple, custard apple, karonda, litchi etc. can be grown in such areas.

5. Food energy: To meet the annual calories requirements of food per year one would have to cultivate about 0.44 ha of wheat or 0.03 ha of banana or 0.06 ha of mango for satisfying once need. Thus mango produces about 9 times more food energy than the wheat produced per unit area.

6. Raw Material for Industries: Fruit farming is the base for several industries like canning, essential oils etc which in turn provide work for more people.

7. Use of Undulating Lands: Fruit growing can be practiced in places where the gradient is uneven or where the land is undulating and agronomical crops cannot be cultivated. In Konkan region, mango and cashew are cultivated on large scales on hilly and hill back area.

C. HORTICULTURE IS ALSO IMPORTANT FOR 3 REASONS

- Economic
- Aesthetic
- Environment

a. Economic Importance

Horticulture puts over billions of rupees in a year into the Indian economy by

- Providing jobs.
- Producing food.
- Fruits.
- Vegetables.
- Nuts.
- Increasing home value through landscaping

b. Aesthetic Importance

- Aesthetic = Appearance
- Improves appearance of homes & buildings through landscaping.
- Improves appearance of land from fruit, vegetable, and ornamental crops grown

c. Environmental Appearance

- Provides health & comfort by
- Cleaning the air.

- Preventing erosion.
- Providing shade.
- Providing nutrition.

SCOPE OF HORTICULTURE

Like any other things, scope of horticulture depends on incentive it has for the farmers, adaptability of the crops, necessity and facilities for future growth through inputs availability and infrastructure for the distribution of produce/marketing etc.

1. Incentive for the farmer:

- The biggest incentive for the farmer is money.
- Horticultural crops provide more returns in terms of per unit area of production, export value, value addition compared to agricultural crops.

2. Adaptability:

- India is bestowed with a great variety of climatic and edaphic conditions as we have climates varying from tropical, subtropical, temperate and within these humid, semi-arid, arid, frost free temperate etc.
- Likewise we have soils from loam, alluvial, laterite, medium black, rocky shallow, heavy black, sandy etc., and thus a large number of crops can be accommodated with very high level of adaptability. Thus, there is lot of scope for horticultural crops.

3. Necessity:

- After having achieved the self sufficiency in food, nutritional security for the people of the country has become the point of consideration/priority.
- To meet the nutritional requirement in terms of vitamins and minerals horticulture crops are to be grown in sufficient quantities to provide a bare minimum of 85 g of fruits and 200 g of vegetables per head per day with a population of above 120 crores.
- Good land is under pressure for stable food, industry, housing, roads and infrastructure due to population explosion and only wasteland had to be efficiently utilized where cultivation of annuals is a gamble due to restricted root zone and their susceptibility of abiotic stress. These lands can be best utilized to cultivate hardy horticultural crops like fruits and medicinal plants.
- At present our share in international trade of horticultural commodities is less than one percent of total trade. Moreover, these commodities (spices, coffee, tea etc.,) fetch 10-20 times more foreign exchange per unit weight than cereals and therefore, taking advantage of globalization of trade, nearness of big market and the size of production, our country should greatly involve in international trade which would provide scope for growth.

4. Export value:

- Among fresh fruits-mangoes and grapes; in vegetables- onion and potato; among flowers, roses; among plantation - cashewnut, tea , coffee, coconut, arecanut, and spice crops like black pepper, cardamom, ginger, turmeric, chillies, etc., constitute the bulk of the export basket.
- European and gulf countries are major importer of horticultural produce

- In the recent past communication and transport system have improved, investment in food industry has increased which will support growth of horticulture through quick deliverance and avoidance of waste.

LECTURE|: 3 HORTICULTURAL AND BOTANICAL CLASSIFICATION

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:

They can stand more in rain than others and therefore grown to flower during rainy season. The time of sowing then would be from April to May in most places e.g. Mary gold, Aster, Salvia, Zinnia etc.

2. Winter or Cold Season Annuals:

They thrive and bloom best during winter. 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. In Temperate climates the tips die off after seasonal growth but root remains alive and produce new stem and tops on favorable conditions. In other words their tips are annual while ground parts are perennials lie many years and are classified as: 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. They either spread on the ground or require some support whether alive or man made e.g. cucurbit vines, Grape vines, Passion fruit etc.

3. Classification of Horticultural Crops Based on Whether they shed Leaves during a Portion of Year

i) Deciduous: Fig., Guava, Apple, Ber, Sweet cherry, Pomegranate, Grape, Mulberry, Phalsa, Almond

ii) Evergreen: Aracanut, Dates, Coconut, Pineapple, Banana, Jackfruit, Avocado, Sweet orange, Mandarin orange, K. lime, Mango, 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 e.g. Apple, Plums cherry and almond etc.

ii) Tropical:

Tropical plants are those which do not tolerate severe cold but can tolerate warm temperatures of about 1000F. Those plants need strong sunshine, warms, humidity and a very mild winter. They cannot stand far against frost e.g. Papaya, Banana and Pineapple.

iii) Sub - Tropical:

Sub - tropical plants like Orange, Litchi, Fig, Mango and cashewnunt are intermediate in character. They need warmth and humidity and can tolerate mild winters.

The above classification, based on climatic preference of plants, is more or less arbitrary and no sharp line can be drawn between these several groups. It however, indicates the broad difference in climatic needs of various plants. 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. Any delay in sowing causes great harm to rain fed crops. Even crops like sunhemp yield their best when sown in a particular optimum season and give even half the normal yield if sown in the strong season

6. Classification of Horticultural Crops based on Use of Horticultural Plants:

Vegetable:

a) Vegetables Grown for Aerial Portion:

1. Cole Crops: Cabbage, cauliflower
2. Legume Crops: Peas and Beans
3. Solanaceous Crops: Tomato Brinjal
4. Cucurbits: Cucumber, Red Pumpkin
5. Leafy Vegetables: Spinach, Methi
6. Salad Vegetables: Lettuce, Brocoli
7. Corn Vegetables: Sweet corn and Popcorn

b) Vegetable Grown for Underground Portion:

1. Root Crops: Beet. Carrot
2. Tuber Crops: Yam, potato.
3. Bulb Crops: Onion and Garlic

ii) Fruits

a) Temperate (Deciduous fruits):

1. Small Fruits: Grape, Strawberry
2. Tree Fruits: Apple, pear, Cherry
3. Nuts: Peach, Walnut

b) Tropical and Sub Tropical:

1. Herbaceous Perennials: Pineapple, Banana
2. Tree Fruits: Mango, Papaya

3. Nuts: Cashewnunt, Aracanut

II) Ornamental Plants

1. Flowering Trees: Gulmohar, Neelmobor, Cassua
2. Road Side Trees: Neem, Baniyan tree, Rain tree
3. Shade Giving Trees: Rain tree, Mahogany
4. Flowering Shrubs: Nerium, Hibiscus, Tagar
5. Foliage Shrubs: Thuja, Casurina
6. Climbers and Creepers: Petrea, Bignonia, Ipomea
7. Bulbous Plants: Canna, Caladium, Tuberose
8. Hedge and Edges: Duranta, Clearadendron, Ageratum
9. Annuals: Pitunia, Ainnia.
10. Perennials: Chrysanthemum, Roses.

CLASSIFICATION OF FRUITS

Classification is the system of grouping or placing of individuals according to nomenclature. It is very useful to the pomologist. It helps to:

- To identify and naming the crop.
- To study the close relationship.
- To know their hybrids and crossing behaviour.
- To know their compatibility & inter grafting ability.
- To know their adoptability to soil & climate.

POMOLOGY: Pomology is a branch of horticulture which deals with study of various aspects of fruits loke, rising of saplings, growing them properly and providing various intercultural operations.

- The term pomology is a combination of two Latin words **„Pome"** means **_Fruits"** and _Logos' means **_study"**.
- **"Poma"** in Greek also meaning *fruits* later subsequently **"Pome"** in Latin word means *fruits*, *logos*-study.
- **Basic Pomology:** Study of basic aspects of fruit production like training, water management, use of PGR's.
- **Commercial Pomology:** It is concerned with commercial production of fruits.
- **Systematic Pomology:** It may be concerned with classification and nomenclature like kingdom, order, class, genus and species.

A. Classification of fruits based on climate adaptability.

In this classification, the fruits trees are categorized into three recognized groups.

i. Temperate fruits:

- Temperate fruit plants are exacting in their climate requirement.
- They are grown only in place where winter is distinctly cold, require as exposure of specific chilling temperature for certain period without which they do not flower.
- These fruit plants are generally deciduous and stand frost. Eg. Apple, almond, peach, pear, plum, strawberry, apricot, persimmon, cherymoya, walnut, peanut, hassle nut, cherry, pistachios and kiwifruits etc.

ii. Tropical fruits:

- Tropical fruit plants are generally evergreen and are extremely sensitive to cold.
- They do well under lesser fluctuations of diurnal temperature, light and dark periods they require a moist warm climate but are capable of withstanding dry weather in some cases Eg; mango, banana, papaya, sapota, etc.,

iii. Sub-tropical fruits:

- The fruit crops grown under a climatic condition between temperate and the tropical are known as subtropical fruit crops.
- They may be either deciduous or evergreen and are usually able to withstand a low temperature but not the frost.
- They are also quite adoptive to fluctuations of light and dark period during day and night.
- Some subtropical fruit plants require chilling for flower bud differentiation.
- Example; grape, citrus, durian, jackfruit, etc.,

B. Classification based on bearing habit: On the basis of bearing habit, fruit trees are classified in to six categories to facilitate cultural operation like pruning, skiffing, heading back etc.

1. Fruit buds bore terminally and giving rise to inflorescence without leaves e.g. Mango, Cherry, etc.
2. Fruit buds borne terminally and unfolding to produce leafy shoots which terminate in flower clusters. e.g. Apple
3. Fruit buds borne terminally and unfolding to produce leafy shoots with flower or flower clusters e.g

Guava

4. Fruit bud borne laterally containing flower parts only and giving rise to inflorescence without leaves or leaves present, they are reduced in size., e.g. Citrus

5. Fruit bud borne laterally and unfolding to produce leafy shoots terminally in flower clusters this type of flowering is noticed in grapes and cashewnut.

6. Fruit buds borne laterally and unfolding to produce leafy shoots with flower clusters in leafy axils. eg.Fig.

C. 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

D. Based on rate of respiration:

Climacteric Fruits	**Non-climacteric Fruits**
Mango, Banana, Sapota, Guava, Papaya, Apple, Fig, Peach, Pear, Plum, Annona, Tomato	Citrus, Grape, Pomegranate Pineapple Litchi, Ber, Jamun, Cashew, Cucumber, Cherry, Strawberry.

E. Based on photoperiodic responses

Long day	**Short day**	**Day neutral plant**
Passion fruit, Banana, Apple	Strawberry, Pineapple, Coffee	Papaya, Guava

F. Based on relative salt tolerance

Highly tolerant	Medium tolerant	Highly sensitive
Datepalm, Ber, Amla, Guava, Coconut, Khirni	Pomegranate, Cashew, Fig, Jamun, Phalsa	Mango, Apple, Citrus, Pear, Straw berry

G. Based on relative acid Tolerance

Highly tolerant	Medium tolerant	Highly sensitive
Stawberry, Raspberry, Fig, Bael, Plum	Pineapple, Avocado, Litchi	-

H. 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

I. 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

2. Botanical classification based on botanical relationship with genomes:

Common name	Botanical name	family	origin	Fruit type	Edible part	Chromosome no.
Aonla	*Emblica officinalis/ Phyllanthus emblica*	Euphorbiaceae	Tropical-asia (indo-china)	Drupecious fruit (berry)	Meso & endocarp	X= 7 2n=4x=28

Atemoya	*Annona atemoya*	Annonaceae	Man made hybrid	Etaerio of berries	Pericarp of individual berries	X=7 2n=2x=14
Custard apple	*Annona squamosa*	Do	Tropical america	Do	Do	Do
Indian wild strawberry	*Fragaria vesca*	Rosaceae	India	Etaerio of achenes	Fleshy thalamus & numerous achenes	X=7 2n=2x=14
Strawberry	*Fragaria X ananassa*	Do	Man made hybrid	Do	Do	X=7 2n=8x=56
Almond	*Prunus amygdalus*	Do	Persia-afganistan	drupe	Kernel/cotyledon	X=8 2n=2x=16
Apricot	*Prunus armeniaca*	Do	china	Do	Meso & endocarpe	Do
European plum	*Prunus domestica*	Do	Europe/ East Asia	Do	Epi & mesocarpe	X=8 2n=6x= 48
Japanese plum	*Prunus salicina*	Do	China	Do	Do	X=8 2n=2x=16
Peach	*Prunus persica*	Do	Do	Do	Do	Do
Sour cherry	*Prunus cerasus*	Do	Europe/ West asia	Do	Do	Do
Sweet cherry	*Prunus avium*	Do	Do	Do	Do	Do, 2n=16,24,32
Pomegranate	*Punica granatum*	Punicaceae	Iran	Balausta	Aril/juicy seed coat	X=8,9 2n=2x=16, 18
Bael	*Aegle marmelos*	Rutaceae	India	Amphisarica	Succulent placenta	X=9 2n=4x=36

Grape fruit	*Citrus paradisi*	Rutaceae	West Indies	Hesperidium	Juicy placental hairs	X=9 2n=2x=18
Indian sweet lime	*Citrus limmetoides*	Do	East Asia	Do	Do	Do
Kagzi lime	*Citrus aurantifolia*	Do	India	Do	Do	Do
Lemon	*Citrus limon*	Do	East Asia	Do	Do	Do
Mandarin	*Citrus reticulata*	Do	China	Do	Do	Do
Pummelo	*Citrus grandis*	Rutaceae	South east asia	Hesperidium	Juicy placental hairs	X=9 2n=2x=18
Sweet orange	*Citrus sinensis*	Do	China	Do	Do	Do
Woodapple	*Feronia limonia*	Do	India	Amphisarica	Succulant placentae	Do
Papaya	*Carica papaya*	Caricaceae	Tropical America	Berry	Mesocarp	X=9 2n=2x/4x=18/36
Passion fruit	*Passiflora eduli*	Passifloraceae	Brazil(Tropical america)	Do	Do	X=9 2n=2x=18
Phalsa	*Grewia subinaequalis*	Tiliaceae	India	Drupe	Epi & mesicarpe	X=9 2n=4x=36
Mango	*Mangifera indica*	Anacardiaceae	Indi-Burma region	Do	Mesocarp	X=10 2n=4x=40
Banana	*Musa acuminata*	Musaceae	South east asia	Berry	Meso & endocarp	X=11 2n=3x=33 4x,2x
Guava	*Psidium*	Myrtaceae	Peru(T.ame	Do	Thalamus &	X=11

	guajava		rica)		pericarp	2n=2x/3x= 22/33
Karonda	*Carissa carandas*	Apocynaceae	India	Do	Epicarp &mesocarp	X=11 2n=2x=22
Rumbutan	*Nephelium lappaceum*	Sapindaceae	Malaya	Nut	Aril	Do
Avocado	*Persea americana*	Lauraceae	Mexico & West indies	Do	Pericarp	X=12 2n=2x=24
Carambola	*Averrhoea carambola*	Oxalidaceae	India-China	Berry		X=12 2n=2x=24
Chinese jujube	*Ziziphus jujube*	Rhamnaceae	China	Drupe	Do	X=12 2n=24,48,96
Indian jujube/ ber	*Ziziphus mauritiana*	Do	India	Do	Do	Do
Tamarind	*Tamarindus indica*	Leguminosae	Tropical Africa-India	Pod/Lomentum	Pulp/Mespcarp	X=12 2n=2x=24
Fig	*Ficus carica*	Moraceae	West asia	Synconus	Fleshy receptacle	X=13 2n=2x=26
Sapota	*Achras sapota*	sapotaceae	Mexico(T. america)	Berry	Mesocarp	Do
Jackfruit	*Artocarpus heterophyllus*	Moraceae	India	sorosis	Bracts/perianth/seeds	X=14 2n=4x=56
Litchi	*Litchi chinensis*	sapindaceae	china	Nut	Aril	X=14,15,16,17 2n=2x=30
Persimmon	*Diospyros*	Ebanaceae	Do	Berry	Epi & mesocarp	X=15

	kaki					2n=6x=90
Coconut	*Cocos nusifera*	Arecaceae	South east asia (India)	Drupe	Endosperm	X=16 2n=2x=32
Walnut	*Juglans regia*	Juglandaceae	South west Europe	Nut	Lobed Cotyledon	Do
Apple	*Malus x domestica*	Rosaceae	Asia minor	Pome	Fleshy Thalamus	X=17 2n=2x/3x=34/51
Loquat	*Eribotrya japonica*	Do	China	Do	Do	2n=2x=34
Quince	*Cydonia oblonga*	Do	Do	Do	Do	Do
Date plum	*Phoenix dactylifera*	Arecaceae	West Asia/Arabia	Berry	Pericarp	X=18 2n=2x=36
Pecan nut	*Carya illinoensis*	juglandaceae	Southern USA	Nut	Seed/Cotyledon	X=16 2n=2x=32
Grape	*Vitis vinifera*	Vitaceae	Black sea to Caspian sea	Berry	Pericarp& Placenta	X=19 2n=2x=38
Jamun	*Syzygium cumini*	Myrtaceae	India	Drupe	Epi & mesocarp	X=20 2n=2x=40
Cashew	*Anacardium occidentale*	Anacardiaceae	Brazil/T.america	Nut	Cotyledon & fleshy peduncle	X=21 2n=2x=42
Olive	*Olea europaea*	oleaceae	Mediterranean region	Drupe	Epi & Mesocarp	X=23 2n=2x=46
Pineapple	*Ananas comosus*	Bromeliaceae	Brazil	Sorosis	Bracts & Perianth	X=25 2n=50,75,100
Chinese gooseberry	*Actinidia chinensis*	Actinidiaceae	China	Berry		X=29

						2n=58,174
Mulberry	*Morus alba*	Moraceae	Do	Syncarpus/sorosis/aggregates of druplets	Mesocarp	2n=308
pistachionut	*Pistachio vera*	Anacardiaceae	West Asia	nut	Cotyledons	X=15 2n=30