CHAPTER 11- HORTICULTURE
HORTICULTURE

Horticulture is a science and technique of production, processing and merchandizing of fruits, vegetables, flowers, spices, plantations, medicinal and aromatic plants.

India is the seventh largest country in the world with a total geographical area of 328.73 m ha and has second largest population 121crores (2011), after China.

- The total arable land available is 144 million hectare of which 52 - 60% is under rain fed cultivation.
- Around 50 % of the total population depends on agriculture and allied activities.
- Horticulture crops constitute a significant portion of total agricultural production in the country.
- The term HORTICULTURE is derived from two Latin words — _HORTUS_ meaning “GARDEN” and _CULTURA_ meaning “CULTIVATION”.
- In ancient days the gardens had protected enclosures with high walls or similar structures surrounding the houses.
- The enclosed places were used to grow fruit, vegetables, flowers and ornamental plants. Therefore, in original sense “Horticulture refers to cultivation of garden plants within protected enclosures”.

Branches of horticulture

Horticulture is a wide field which includes a great variety and diversity of crops. The science of horticulture can be divided into several branches depending upon the crops it deals with.

Following are the branches of horticulture.

- **Pomology**: study of fruit crops.
- **Olericulture**: cultivation of vegetables.
- **Floriculture**: cultivation of flower crops.
- **Plantation crops**: cultivation of coconut, arecanut, rubber, coffee, tea, etc.
- **Spices crops**: cultivation of cardamom, pepper, nutmeg etc.
- **Medicinal and aromatic crops**: cultivation of medicinal and aromatic crops.
- **Post harvest technology**: deals with post-harvest handling, grading, packaging, storage processing, value addition, marketing etc., of horticulture crops.
- **Plant propagation**: deals with propagation of plants

Important Facts
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edible part of cauliflower is:</td>
<td>Curd</td>
</tr>
<tr>
<td>Blanching is an important process of:</td>
<td>Cauliflower</td>
</tr>
<tr>
<td>Whiptail of cauliflower is due to:</td>
<td>MO Deficiency</td>
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<tr>
<td>Pusa ruby is a variety of:</td>
<td>Tomato</td>
</tr>
<tr>
<td>Swaran roopa is the early variety of:</td>
<td>Litchi</td>
</tr>
<tr>
<td>Pajaro is the variety of:</td>
<td>Strawberry</td>
</tr>
<tr>
<td>Bolerois the variety of:</td>
<td>Marigold</td>
</tr>
<tr>
<td>Richest source of vitamin C is:</td>
<td>Barbados cherry</td>
</tr>
<tr>
<td>Largest importer of cut flower in the world:</td>
<td>Germany</td>
</tr>
<tr>
<td>The dwarf variety of mango:</td>
<td>Amrapali</td>
</tr>
<tr>
<td>California Papershell is the variety of:</td>
<td>Almond</td>
</tr>
<tr>
<td>Fruit of rose is known as:</td>
<td>Hips</td>
</tr>
<tr>
<td>Fruit of okra is a:</td>
<td>Capsule</td>
</tr>
<tr>
<td>Coconut fat is a rich source of:</td>
<td>Lauric acid</td>
</tr>
<tr>
<td>Coconut is propagated by:</td>
<td>Seeds</td>
</tr>
<tr>
<td>Mango is mostly propagated through:</td>
<td>Veneer grafting</td>
</tr>
<tr>
<td>Inflorescence of cauliflower is known as:</td>
<td>Cyme</td>
</tr>
<tr>
<td>Inflorescence of cabbage is known as:</td>
<td>Cat ken</td>
</tr>
<tr>
<td>Black heart of potato is due to:</td>
<td>O₂ deficiency</td>
</tr>
<tr>
<td>Pusa snowball is a variety of:</td>
<td>Cauliflower</td>
</tr>
<tr>
<td>India's share in the fruit production in the World is:</td>
<td>10%</td>
</tr>
<tr>
<td>Development of fruits without fertilization is called:</td>
<td>Parthenocarpy</td>
</tr>
<tr>
<td>Description</td>
<td>Answer</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------</td>
<td>---------------------------------------------</td>
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<tr>
<td>Development of embryo without fertilization is known as:</td>
<td>Apomixis</td>
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<tr>
<td>Oleoresin is an important product of:</td>
<td>Chilli seeds or spices</td>
</tr>
<tr>
<td>Kesar (saffron) belong to the family of:</td>
<td>Iridiceae</td>
</tr>
<tr>
<td>Concentration of sugar is used for preservation is:</td>
<td>60-70%</td>
</tr>
<tr>
<td>Mango variety suitable for high density planting is:</td>
<td>Amrapali</td>
</tr>
<tr>
<td>Most salt tolerant fruit crop is:</td>
<td>Date Palm</td>
</tr>
<tr>
<td>Fruit repining hormone is:</td>
<td>Ethylene</td>
</tr>
<tr>
<td>A form of low pruning upto 2 m height of stem is called as</td>
<td>Pollarding</td>
</tr>
<tr>
<td>Early variety of ber is:</td>
<td>Gola, Seb</td>
</tr>
<tr>
<td>Planting season for deciduous plants is</td>
<td>Jan-Feb</td>
</tr>
<tr>
<td>The varicy of date- palm is used for dry dates (Chhuara)</td>
<td>Halawi</td>
</tr>
<tr>
<td>Generally fruits are in:</td>
<td>Acidic nature</td>
</tr>
<tr>
<td>Baradari is an important feature of:</td>
<td>Mughal garden</td>
</tr>
<tr>
<td>The fruit of pine apple is known as:</td>
<td>Sorosis</td>
</tr>
<tr>
<td>Which crop is propagated by means of bulbils (clove):</td>
<td>Garlic</td>
</tr>
<tr>
<td>Edible banana fruit is seedless because of:</td>
<td>Ambryo abortion</td>
</tr>
<tr>
<td>Multistoried cropping is popular in:</td>
<td>Coconut plantation</td>
</tr>
<tr>
<td>Which is the late ripening cultivar of ber:</td>
<td>Umran</td>
</tr>
<tr>
<td>The exclusion of micro-organism is known as:</td>
<td>Asepsis</td>
</tr>
<tr>
<td>Production of vegetables out of their normal season (off season) is known as:</td>
<td>Vegetable forcing</td>
</tr>
<tr>
<td>'Alphanso&quot; variety of mango is grown in:</td>
<td>Maharastra</td>
</tr>
<tr>
<td>Question</td>
<td>Answer</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>The chemical preservative used for colorless fruits is:</td>
<td>KMS</td>
</tr>
<tr>
<td>Shade loving annual flower plant is:</td>
<td>Salvia</td>
</tr>
<tr>
<td>The commonly cultivated variety of table pea in India is:</td>
<td>Bonneville</td>
</tr>
<tr>
<td>Crescent is well known for:</td>
<td>Flower arrangement</td>
</tr>
<tr>
<td>Saffron is obtained from:</td>
<td>Style and Stigma</td>
</tr>
<tr>
<td>Grapes are generally dried in:</td>
<td>Sun</td>
</tr>
<tr>
<td>Sago(Sabudana) is prepared from:</td>
<td>Roots of Cassava/Topiaca</td>
</tr>
<tr>
<td>Feni (drink) is prepared by:</td>
<td>Cashew apple &amp; Coconut</td>
</tr>
<tr>
<td>Cider is prepared by:</td>
<td>Apple &amp; pear</td>
</tr>
<tr>
<td>Tea is commonly propagated by:</td>
<td>Soft wood cutting</td>
</tr>
<tr>
<td>Origin place of Date palm is:</td>
<td>Iraq</td>
</tr>
<tr>
<td>Spacing recommended for Pusa Nanha variety of papaya is:</td>
<td>1.25 x 1.25 m</td>
</tr>
<tr>
<td>Maximum litchi producing state is:</td>
<td>Bihar</td>
</tr>
<tr>
<td>Onion variety which is suitable for export &amp; having yellow colour:</td>
<td>Phule suwarna</td>
</tr>
<tr>
<td>The hard fruits of citrus are due to the:</td>
<td>Boron deficiency</td>
</tr>
<tr>
<td>Bael is the richest source of:</td>
<td>Vit-B2 (riboflavin)</td>
</tr>
<tr>
<td>Leaves of Bael have religious importance and used to offer:</td>
<td>'Lord Shiva'</td>
</tr>
<tr>
<td>Causal organism of Fig rust is:</td>
<td>Cerotolium fici</td>
</tr>
<tr>
<td>Peach leaf curl is caused by fungus:</td>
<td>Taphrina deformens</td>
</tr>
<tr>
<td>Sanjose scale is the most serious pest of:</td>
<td>Apple</td>
</tr>
<tr>
<td>Kent is the mutant variety of:</td>
<td>Coffee</td>
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<tr>
<td>--------------------------------</td>
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<tr>
<td>Rekha, Swarna Rekha &amp; Rajjat rekha are varieties of:</td>
<td>Tuberose</td>
</tr>
<tr>
<td>Fruits which have polyembryonic nature are:</td>
<td>Mango, Citrus, Jamun.</td>
</tr>
<tr>
<td>When pollination is carried out by insects is known as:</td>
<td>Entomophilous</td>
</tr>
<tr>
<td>Pollination in mango is carried by:</td>
<td>House flies</td>
</tr>
<tr>
<td>Pollination in fig is carried by:</td>
<td>Fig wasp</td>
</tr>
<tr>
<td>Pollination in oil palm is carried by:</td>
<td>Weevil</td>
</tr>
<tr>
<td>Center of origin of Isabgol and Sarpagandha is:</td>
<td>India</td>
</tr>
<tr>
<td>Center of origin of Bael, Phalsa and Kagzilime is:</td>
<td>India</td>
</tr>
<tr>
<td>Origin of orchid is:</td>
<td>India</td>
</tr>
<tr>
<td>Double century is the variety of:</td>
<td>Coconut</td>
</tr>
<tr>
<td>Finest fruit of the world:</td>
<td>Mango Steen</td>
</tr>
<tr>
<td>Dioecious fruit plants are:</td>
<td>Papaya, Datepalm</td>
</tr>
<tr>
<td>Gynodioecious fruit:</td>
<td>Fig, Papaya</td>
</tr>
<tr>
<td>Pollu beetle (Longitarsus nigripenis) is the pest of:</td>
<td>Black pepper</td>
</tr>
<tr>
<td>Pusa chikni is a variety of:</td>
<td>Sponge gourd</td>
</tr>
<tr>
<td>The clove required for planting garlic/ha is:</td>
<td>500 kg</td>
</tr>
<tr>
<td>Cucumber is native of:</td>
<td>India</td>
</tr>
<tr>
<td>Water melon is native of:</td>
<td>T. Africa</td>
</tr>
<tr>
<td>Sponge gourd is:</td>
<td>Luffa cylindirica.</td>
</tr>
<tr>
<td>Most serious disease of rose:</td>
<td>Die back</td>
</tr>
<tr>
<td>Tissue culture is common in:</td>
<td>Orchid</td>
</tr>
<tr>
<td><strong>Annual flower of Indian origin is:</strong></td>
<td><strong>Gomphrena</strong></td>
</tr>
<tr>
<td><strong>Popular climber of Indian origin is:</strong></td>
<td><strong>Gloriosa superba</strong></td>
</tr>
<tr>
<td><strong>Annual flower suited for planting in shade is:</strong></td>
<td><strong>Cineraria</strong></td>
</tr>
<tr>
<td><strong>Karonda is richest source of:</strong></td>
<td><strong>Iron</strong></td>
</tr>
<tr>
<td><strong>Maroon is the variety of:</strong></td>
<td><strong>Karonda</strong></td>
</tr>
<tr>
<td><strong>Powdery mildew disease in mango is caused due to:</strong></td>
<td><strong>Odium mangiferae</strong></td>
</tr>
<tr>
<td><strong>Naphthalene acetic acid (NAA) is used in mango to control:</strong></td>
<td><strong>Mango Malformation</strong></td>
</tr>
<tr>
<td><strong>Vegetable which is known as multivitamin greens:</strong></td>
<td><strong>Chekurmanis</strong></td>
</tr>
<tr>
<td><strong>In which flower arrangement fruit, flower &amp; foliage are used.</strong></td>
<td><strong>Morimania</strong></td>
</tr>
<tr>
<td><strong>Clove, commonly used spice is obtained from which part of the plant:</strong></td>
<td><strong>Flower</strong></td>
</tr>
<tr>
<td><strong>Higher temperature induces which type of flower in bottle gourd:</strong></td>
<td><strong>Male</strong></td>
</tr>
<tr>
<td><strong>Planting system which accommodates maximum number of plants in the orchard</strong></td>
<td><strong>Filler System</strong></td>
</tr>
<tr>
<td><strong>Cricket ball and Murrabba are the popular varieties of:</strong></td>
<td><strong>Sapota</strong></td>
</tr>
<tr>
<td><strong>Scartlet gold and Red fuzi are the high yielding varieties of:</strong></td>
<td><strong>Apple</strong></td>
</tr>
<tr>
<td><strong>The chemical used to prevent sprouting during storage of onion is:</strong></td>
<td><strong>MH (Maleic Hydrazide)</strong></td>
</tr>
<tr>
<td><strong>Rayan as rootstock is most accepted for commercial propagation of:</strong></td>
<td><strong>Sapota</strong></td>
</tr>
<tr>
<td><strong>Most promising rootstock for mandarins and sweet orange is:</strong></td>
<td><strong>Rangpur line</strong></td>
</tr>
<tr>
<td><strong>Teamosquito bug (Helopeltis antonii) is a pest of:</strong></td>
<td><strong>Cashew</strong></td>
</tr>
<tr>
<td><strong>Coffeeberry borer (Hypothenemus hampei) is a serious pest of:</strong></td>
<td><strong>Coffee</strong></td>
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<tr>
<td>Question</td>
<td>Answer</td>
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<tr>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Trimming (removal of undesired plant parts) is generally done in</td>
<td>Rose and Marigold</td>
</tr>
<tr>
<td>Bromalin: enzyme is obtained from:</td>
<td>Pineapple</td>
</tr>
<tr>
<td>Aroma in fruits is due to presence of:</td>
<td>Esters</td>
</tr>
<tr>
<td>Acid content is a very important consideration for the preparation of:</td>
<td>Jam</td>
</tr>
<tr>
<td>Domestic quarantine in India exist for:</td>
<td>Sanjose scale</td>
</tr>
<tr>
<td>Upper part of stem for grafting is called:</td>
<td>Scion</td>
</tr>
<tr>
<td>In onion bolting takes place due to:</td>
<td>Low temp (except N-53)</td>
</tr>
<tr>
<td>Hand pollination is most useful in:</td>
<td>Date palm</td>
</tr>
<tr>
<td>Highest source of energy:</td>
<td>Walnut</td>
</tr>
<tr>
<td>Hogarth curve is also known as:</td>
<td>Line of beauty</td>
</tr>
<tr>
<td>Fruit of new world.</td>
<td>Avacado</td>
</tr>
<tr>
<td>Orchid is propagated by:</td>
<td>Micro propagation</td>
</tr>
<tr>
<td>Most important fruit used in processing industries in India:</td>
<td>Pine Apple</td>
</tr>
<tr>
<td>Pagoda is a name of:</td>
<td>Japanese monument</td>
</tr>
<tr>
<td>Red colour in jelly is due to:</td>
<td>Charring of sugar</td>
</tr>
<tr>
<td>Vista vision is a theme for:</td>
<td>Landscape</td>
</tr>
<tr>
<td>Vegetable crop whose all parts are edible is:</td>
<td>winged bean</td>
</tr>
<tr>
<td>Sex form of pointed gourd is:</td>
<td>Dioecious</td>
</tr>
<tr>
<td>Primitive sex form of cucumber is:</td>
<td>Monoecious</td>
</tr>
<tr>
<td>The best site for the seed production of temperate type varieties of vegetables is:</td>
<td>Hills</td>
</tr>
</tbody>
</table>
Edible part of lettuce is: **Leaf**

Edible part of parsley is: **Leaves**

Edible portion of celery is: **Leaf stalk**

- **Asparagus** is a perennial crop
- Edible parts of asparagus are: Underground young shoots (known as spears)
- Sex ratio in cucurbits can be modified by: **Silver nitrate**
- Bolting (emergence of seed stalk prior to their time of formation) is a disorder of: **Onion and cabbage** (bolting in onion due to cold temp. fluctuations and in cabbage due to raising temperature above 75 °F) Blindness (absence of curd or head in Cole crops) is a disorder of: Cole crops due to frost
- Buttoning (Formation of small curds in cauliflower) is due to: **Deficiency of nitrogen**
- Blanching in vegetables is done: To inactivate enzyme activities
- Seed of carrot is known as: **Schizocarp**
- Forking of carrot is due to: Compact soil & application Of undecomposed FYM
- Harvesting stage for long distance transport of muskmelon is: Half-slip stage
- Chief pollinating agent in onion is: **Honey bee**
- Sex form of water melon is: **Monoecious**
- Seed rate of hybrid tomato is: 100-150 g/ha Origin of cucumber: **India**
- Physiological process responsible for rapid deterioration of fruits and vegetables is: **Respiration**
- Serious disease of cumin are: **wilt and blight**
- Sugary disease is common in fennel is caused by: **Virus**
- Vitamin C act as: **Anti-oxidants**
- Tuberization of potato requires: Short day length (temp. < 21°C)
- The nutrient improve quality of fruits is: **Boron**
- Onion varieties suitable for dehydration: White coloured
- Anti-fungal factor in onion is: **Catechol**
- Vitamin lost during processing is: **Vitamin C**
- Rutabaga is a man-made vegetable is a cross between: **Brassica oleracea x B. napus**
- Self-incompatibility exists in mango, aonla, apple, almond and cherry. India is the largest producer, processor, consumer and exporter of cashew in the world.
- Major tea growing pockets are located in Assam (53%), West Bengal (23%), Tamil Nadu (11%) and Kerala (8%).

**Horticulture Institutes**

<table>
<thead>
<tr>
<th>Abbr.</th>
<th>Name of Institute</th>
<th>Place</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>CISTH</td>
<td>Central Institute for Subtropical Horticulture</td>
<td>Lucknow</td>
<td>Uttar Pradesh</td>
</tr>
<tr>
<td>CITH</td>
<td>Central Institute of Temperate Horticulture</td>
<td>Srinagar</td>
<td>Jammu and Kashmir</td>
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<tr>
<td>CTCRI</td>
<td>Central Tuber Crops Research Institute</td>
<td>Thiruvanthapuram</td>
<td>Kerala</td>
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<tr>
<td>CPCRI</td>
<td>Central Plantation Crops Research Institute</td>
<td>Kessorgod</td>
<td>Kerala</td>
</tr>
<tr>
<td>CPRI</td>
<td>Central Potato Research Institute</td>
<td>Kufri</td>
<td>Himachal Pradesh</td>
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<tr>
<td>IIHR</td>
<td>Indian Institute of Horticultural Research</td>
<td>Bangalore</td>
<td>Karnataka</td>
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<tr>
<td>IISR</td>
<td>Indian Institute of Spices Research</td>
<td>Calicut</td>
<td>Kerala</td>
</tr>
<tr>
<td>CIAH</td>
<td>Central Institute for Arid Horticulture</td>
<td>Bikaner</td>
<td>Rajasthan</td>
</tr>
<tr>
<td>CRIC</td>
<td>Central Research Institute for Chikoo</td>
<td>Muzaffarpur</td>
<td>Bihar</td>
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<tr>
<td>NRCB</td>
<td>National Research Center for Banana</td>
<td>Tiruchirapali</td>
<td>Tamil Nadu</td>
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<tr>
<td>NRCC</td>
<td>National Research Center for Cashew</td>
<td>Puttur</td>
<td>Kerala</td>
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</tbody>
</table>
FRUIT CROPS:

- India is the second largest producer of fruits after Brazil.
- A large variety of fruit crops are grown in India. Of these, mango, banana, citrus, papaya, guava, pineapple, sapota, jackfruit, litchi, grapes, apple, pear, peach, plum, walnut etc. are the important ones.
- India accounts for 10 per cent of the total world production of fruits.
- It leads the world in the production of mango, banana, sapota and acid lime besides recording highest productivity in grape.
- The leading fruit growing states are Maharashtra, Karnataka, Andhra Pradesh, Bihar and Uttar Pradesh.
VEGETABLE CROPS:

- More than 40 vegetables belonging to Solanaceaeous, cucurbitaceous, leguminous, cruciferous, root crops and leafy vegetables are grown in Indian tropical, sub-tropical and temperate regions.
- Important vegetables grown in India are onion, tomato, potato, brinjal, peas, beans, okra, chilli, cabbage, cauliflower, bottle gourd, cucumber, watermelon, carrot, radish etc.
- India ranks second in vegetable production next to China w.r.t. area and production contributing 13.38% to the total world production.
- India occupies first position in cauliflower, second in onion, third in cabbage in the world.
- West Bengal, Orissa, Uttar Pradesh, Bihar, Maharashtra, Karnataka are the important states for horticultural crop production.

FLORICULTURE:

- In India, flower cultivation is being practiced since ages.
- It is an important/integral part of socio-cultural and religious life of Indian people.
- It has taken a shape of industry in recent years.
- India is known for growing traditional flowers such as jasmine, marigold, chrysanthemum, tuberose, crossandra, aster, etc.
- Commercial cultivation of cut flowers like, rose, orchids, gladiolus, carnation, anthurium, gerbera is also being done.
- The important flower growing states are Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra, West Bengal, Sikkim, Jammu & Kashmir, Meghalaya, etc.

PLANTATION CROPS:

- This is one of the important sectors contributing about Rs. 7,500 crores of export earnings.
The major plantation crops include coconut, oil palm, cashew, tea coffee, rubber cocoa, betel vine, vanilla etc.

The leading states are Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Maharashtra, Goa, Assam etc.

SPICES:

- They constitute an important group of horticulture crops and are defined as vegetable products or mixture thereof,
- Free from extraneous matter used for flavouring, seasoning and imparting aroma in foods.
- India is known as home of spices producing a wide variety of spices like black pepper, cardamom, ginger, turmeric, chilli, Coriander etc.
- Major spice producing states are Kerala, Andhra Pradesh, Gujarat, Rajasthan, Maharashtra, Karnataka, Orissa, Tamil Nadu etc.

MEDICINAL AND AROMATIC PLANTS:

- India has diverse collection of medicinal and aromatic plants species distributed throughout the country.
- It has more than 9,500 species with medicinal properties.
- Demand for these crops is increasing progressively in both domestic and export markets.
- Important medicinal plants are Isabgol, Senna, Opium poppy, Periwinkle, Coleus, Ashwagandha, etc. and aromatic plants are Japanese mint, Lemon grass, Citronella, Davana, Patchouli etc.

FEATURES OF HORTICULTURE IN GENERAL

- Horticultural produces are mostly utilized in the fresh state and are highly perishable nature.
- Horticultural crops need intensive cultivation, requires large input of capital, labour and technology per unit area.
Cultural operations like propagation, training, pruning and harvesting are skilled and specific to horticultural crops.

Horticultural produce are rich sources of vitamins and minerals and alkaloids.

Aesthetic satisfaction is an exclusive phenomenon to horticultural science.

Table 2.4: Percentage Share of Production of various Horticulture Crops in Total Horticulture for Last Five Years

<table>
<thead>
<tr>
<th>Crops</th>
<th>2012-13</th>
<th>2013-14</th>
<th>2014-15</th>
<th>2015-16</th>
<th>2016-17 (Provisional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruits</td>
<td>30.2</td>
<td>32.1</td>
<td>30.8</td>
<td>31.5</td>
<td>31.5</td>
</tr>
<tr>
<td>Vegetables</td>
<td>60.3</td>
<td>58.7</td>
<td>60.3</td>
<td>59.1</td>
<td>59.3</td>
</tr>
<tr>
<td>Flowers &amp; Aromatics</td>
<td>1.0</td>
<td>1.0</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Plantation Crops</td>
<td>6.3</td>
<td>5.9</td>
<td>5.5</td>
<td>5.8</td>
<td>5.7</td>
</tr>
<tr>
<td>Spices</td>
<td>2.1</td>
<td>2.1</td>
<td>2.2</td>
<td>2.4</td>
<td>2.4</td>
</tr>
<tr>
<td>Total Horticulture</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Leading Fruit Producing States (2016-17 Provisional)
Table 2.5: Production of Horticulture vis-à-vis Foodgrains

<table>
<thead>
<tr>
<th>Year</th>
<th>Production (In Million Tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Horticulture</td>
</tr>
<tr>
<td>2016-17(Provisional)</td>
<td>295.16</td>
</tr>
</tbody>
</table>
IMPORATANCE OF HORTICULTURE

- Apart from fruits and vegetables, floriculture industry in India comprising of florist trade, nursery plants, potted plants, seed and bulb products is being observed as sunrise industry.
- There is roaring business of flowers in almost all metropolitan cities of the different states.
- The traditional flowers are grown on a large area on a commercial scale. These flowers are mostly grown for loose flower purpose.
- Area under cut flowers like rose, chrysanthemum, gladiolus, carnation and orchids is increasing day by day.
- Plantation crops are another potential sector with lot of opportunities for employment generation, foreign exchange earnings and overall supporting livelihood sustenance of mankind at large.
- These plantation crops form the mainstay of lively hood in coastal areas of the country where predominating stands of plantation crops are found.
- Coconut has so much importance in the country that the state Kerala receives its very name on the basis of coconut, the Malayalam name of which is Kera.

Horticulture is important due to the following considerations:

a. as a source of variability in produce.

b. as a source of nutrients, vitamins, minerals, flavour, aroma, alkaloids, oleoresins, fibre, etc.

c. as a source of medicine.

d. as an economic proposition as they give higher returns per unit area in terms of energy, money, job, etc.

e. Employment generation
f. Effective utilization of waste land through cultivation of hardy fruits and medicinal plants.

g. As a substitute for family income being the component of home garden/ kitchen garden.

h. As a foreign exchange earner, has higher share compare to agriculture crops

i. As an input for industry being amenable to processing, especially fruit and vegetable preservation industry.

j. Aesthetic consideration and protection of the environment.

k. Religious significance in the country.

In short and sweet horticulture supplies quality food for health and mind, more calories per unit area, develops better resources and yields higher returns per unit area.

It also enhances land value and creates better purchasing power for those who are engaged in this industry. Therefore, horticulture is important for health, wealth, hygiene and happiness.

**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 per cent 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.

**Reasons for scope of Horticulture in India are:**

1. To exploit the great variability of agro climatic conditions in the country.

2. To meet the need for fruits, vegetables, flowers, spices, beverages in relation to population growth based on minimum nutritional security and for other needs.

3. To meet the requirement of processing industry.

4. To substitute import and increase export.

5. To improve the economic conditions of the farmers and to engage more labourers to avoid the problem of unemployment.

6. To protect environment.

◆ **Horticultural crops and Human Nutrition:**

- Fruits and vegetables play an important role in balanced diet.
- These provide not only energy rich food but also provide vital protective nutrients/elements and vitamins.
- Comparatively fruits and vegetables are the cheapest source of natural nutritive foods.
- Since most of Indians are vegetarians, the incorporation of horticulture produce in daily diet is essential for good health.
• Realizing the worth of fruits and vegetables in human health, Indian Council of Medical Research (ICMR) recommended the use of **120g fruits** and **280 g vegetables per capita** per day.

• With the growing awareness and inclination towards vegetarianism worldwide the horticulture crops are gaining tremendous importance.

**Functions of fruits and vegetables in human body:**

1. Fruits and vegetables provide palatability/taste,
2. Improves appetite and provides fibre to overcome constipation.
3. They neutralize the acids produced during digestion of proteins and fatty acids.
4. They improve the general immunity of human body against diseases, deficiencies etc.
5. They are the important source of vitamins and minerals for used in several biochemical reactions occur in body.
6. Fruits and vegetables provide higher energy value per unit area compared to cereals.

• **Some of the essential nutrients provided by different fruits are:**
  (i) Fruits are also a good source of energy. Eg. Avocado, Olive etc.,
  (ii) Fruits are also a good source of enzymes which are helpful in metabolic activities leading to proper digestion of food. Eg. Jamun and Papaya.
  (iii) All fruits have one or the other medicinal value.
  (iv) They should be eaten in adequate quantity.
  (v) Regular consumption of fruits reduces obesity, maintain health and increase the longevity of life.
  (vi) Fruits are attractive in appearance, delicious in taste and easily digestible.

Therefore, they are liked by young and old alike.
<table>
<thead>
<tr>
<th>Vitamins/Minerals</th>
<th>Role in human body</th>
<th>Source</th>
</tr>
</thead>
</table>
                    2. Helps in resistance to infections, increases longevity and decreases senility.  
                    3. Deficiency causes night blindness, xerophthalmia, retardation in growth, roughness in skin, formation of stones in kidney. | Mango, Papaya, Persimmon, Dates, Jack fruit, Walnut, Oranges, Passion fruit, Loquat etc.  
                        Coriander leaves, Drumstick leaves, Fenugreek leaves etc. |
| Vitamin-B₁        | 1. For maintaining good appetite and normal digestion.  
                    2. Necessary for growth, fertility, lactation and for normal functioning of nervous system.  
                    3. Deficiency causes beri-beri, paralysis, loss the sensitivity of skin, enlargement of heart, loss of appetite and fall in body temperature. | Walnut, Apricot, Apple, Banana, Grapefruit, Plum and Almond  
                        Chillies, Colocasia leaves, Tomato, etc. |
| Vitamin-B₂        | 1. Important for growth, health of skin and for respiration in poorly vascularised tissue such as the cornea.  
                    2. Deficiency causes pellagra and alopecia, loss of appetite, loss of weight, sore throat, and development of cataract, swollen nose and baldness. | Bael, Papaya, Liichi, Pomegranate, Wood apple and Pineapple  
                        Amaranthus, Fenugreek leaves etc |
| Vitamin-C         | 1. Deficiency causes scurvy, pain in joints, swelling of limbs, unhealthy gums, tooth decay, delay in wound healing and rheumatism. | Barbados cherry, Aonla, Guava, Lime, Lemon, Sweet oranges, Ber, Pineapple and Pear.  
                        Chillies, Tomato, Coriander leaves, Drumstick leaves etc. |
| Fat               | Walnut, Almond, Avocado |
| Fibre             | Guava, Pomegranate, Aonla, Grape, Amaranth, Mustard, Beet leaf, Spinach etc. |

**Minerals are essential for the growth and development for the human body:**

<table>
<thead>
<tr>
<th>Minerals</th>
<th>Deficiency causes</th>
<th>Sources</th>
</tr>
</thead>
</table>
| 1. Calcium | Causes Rickets, Osteomalacia. | Sitaphal, Ramphal, Fig, Phalsa, Citrus, Sapota, Grapes, West Indian Cherry etc.  
                        Curry leaves, Amaranthus, Radish leaves, Fenugreek leaves etc |
| 3. Proteins | Important for body growth, formation and maintenance of body tissues | West Indian cherry, Avocado, Custrad Apple, Banana, Apricot, Guava, Grapes etc.,  
                        Peas, cowpea, Bean etc. |
| 4. Iron | Act as oxygen carrier in the body. | Karonda, Date palm, Grape raisins, West Indian Cherry, Guava, Sitaphal, Avocado, Sapota, plum etc.  
                        Amaranthus tender, Coriander leaves etc. |
FRUIT ZONES

Tropical fruit zone:
- This class includes fruit crops which are ever green unable to endure cool temperature but can tolerate warm temperature.
- The fruit plants of this zone need strong sunshine warm and humid climate and a very mild winter.
- They cannot stand against frost. Areas under this zone include West Bengal, Parts of Punjab, Haryana, Rajasthan Orissa, Maharastra, AP, Karnataka, TN and Kerala.
- Fruits crops: Banana, Pineapple, Sapota, Papaya, Cashew, Pomegranate.

Sub- tropical fruit Zone:
- This class includes fruit crops intermediate characters to tropical and temperatures.
- The summer is hot and dry and winter is less mild.
- They may be either deciduous or ever green & are usually able to withstand a low temperature but not the frost.
- Some require chilling for flower bud differentiation.
- The fruits grow mostly in plains.
- The fruits include Citrus, Grapes, Phalsa, fig, guava, pomegranate, Banana etc.
- This fruit zone covers the plains of Punjab, UP, Parts of Bihar, MP, WB, Maharastra, Rajasthan, Karnataka, AP, TN, Kerala, Orissa. etc.

Temperate fruit zone:
- This class of fruits grows successfully in cold regions where temperature falls below freezing point during winter.
- During the cold season, the trees shed their leaves and go into rest period.
- For breaking the rest/dormant period, a definite chilling period is required. This chilling temperature helps the plants to put forth new growth, flowering and fruiting with the onset of spring season.
- The regions under this zone are J&K, Kulu valley, HP, Parts, Peaches, Plum, Cherries, Almond, Walnut, Strawberry, Apricot, persimmon, Pecan nut, Kiwi fruit etc.

**Arid Zone:**
- The arid zone has an extreme climatic condition, high temperature low humidity, rainfall is very low and its distribution is erratic, poor textured soil.
- The area of Rajasthan (62%) and Gujarat (20%) parts of the Punjab, Haryana, Karnataka & Maharashtra.
- The crops are Phalsa, Date palm, Pomegranate, Ber, Custard apple, Tamarind etc.

**Semi-arid zone:**
- This region exhibits low and erratic rainfall, low humidity and high temperature.
- Fruits of arid region can be cultivated in this zone also Mango, Sapota, Guava, Jack, Avocado, Ber, Pomegranate and Tamarind etc.

**North-Eastern sub-Tropical zone:**
- All tropical and sub-tropical fruits are grown in this region.

**North-Western region:**
- It is again classified into 4 regions; temperate- low winter temperature, dry temperature- highly cold condition, Sub- temperate- winter temperature & lesser cold, Low hill valley- low winter temperature & lesser cold.
- Parts of J&K, HP, hills of UP, South of Punjab and Haryana.

**Central tropical fruit zone:**
- This region covers Southern parts of MP, Maharastra Orissa, parts AP, WB, Gujarat etc.

- **South tropical fruit zone:**
  - Karnataka, TN, Kerala & AP

- **Coastal tropical fruit zone:**
  - Kerala, Goa, Diu-Daman, Tripura, Coastal parts of Maharastra, AP, WB, TN, Orissa, Karnataka.

- **Humid zone fruit crops:**
  - This region is characterized by low temperature and high humidity.
  - The crops are Litchi, Strawberry, Avocado, Mangosteen, Passion fruit etc.
  - Apart from these fruit zones, India has been classified into 21 agro ecological regions based on the physiography of soils, bioclimatic types and growing periods.

- **Epithets for fruits/crops**

<table>
<thead>
<tr>
<th>King of fruits</th>
<th>Mango</th>
</tr>
</thead>
<tbody>
<tr>
<td>Queen of fruits</td>
<td>Litchi</td>
</tr>
<tr>
<td>King of pulses:</td>
<td>Gram</td>
</tr>
<tr>
<td>Queen of pulses:</td>
<td>Pea</td>
</tr>
<tr>
<td>Queen of spices:</td>
<td>Cardamom</td>
</tr>
<tr>
<td>Queen of flowers:</td>
<td>Gladiolus</td>
</tr>
<tr>
<td>Queen of beverage:</td>
<td>Tea</td>
</tr>
<tr>
<td>King of temperate fruits:</td>
<td>Apple</td>
</tr>
<tr>
<td>Butter fruits:</td>
<td>Avocado</td>
</tr>
<tr>
<td>King of arid fruits:</td>
<td>Ber</td>
</tr>
<tr>
<td>Poor man's fruits:</td>
<td>Ber</td>
</tr>
<tr>
<td>Kalp vrkasha:</td>
<td>Coconut</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Miracle fruit:</td>
<td>China kiwi fruit</td>
</tr>
<tr>
<td>White gold:</td>
<td>Cotton</td>
</tr>
<tr>
<td>Century plant:</td>
<td>Date palm</td>
</tr>
<tr>
<td>Adam's fig:</td>
<td>Banana</td>
</tr>
<tr>
<td>King of forest:</td>
<td>Teak</td>
</tr>
<tr>
<td>Food of god:</td>
<td>Cocoa</td>
</tr>
</tbody>
</table>

**Fruit Production**

1. **MANGO:**
   - Known as **national fruit** of India/king of fruits.
   - Fruit type of mango: **Drupe/stone**
   - Origin of mango was: Indo-Burma
   - Edible part of mango is known as: Mesocarp.
   - Highly cross pollinated mediated by: House fly
   - India's rank in mango production: First (50% of world)
   - State first in mango production is: **Uttar Pradesh**
   - Mango is the richest source of: Vitamin A
   - Rumani used for dwarfing effect in: Dasheri
   - Major pest of mango: Mango hopper
   - Major disease of mango: Powdery mildew
   - Mango malformation is due to: Low temperature & fungi.
   - Spongy tissue is due to: Convection heats.
   - Internal fruit necrosis is due to: Boron deficiency.
   - Deblossoming is done for: Control of malformation.
   - In mango, only 0.1 % flower develops fruits to maturity.
- VHT (vapour heat treatment) is recommended for disinfection of mango against fruit flies and stone weevil.
- **Kanyakumari and Madurai districts of Tamil Nadu** produce two crops of mango in a year.
- **Alphonso**: it is commercial variety of mango in Maharashtra
- Propagation of mango is done by: Veneer grafting
- Sai sugandha: It is regular bearing variety and free from malformation.
- Soil: Well drained loamy soil.
- Planting time: June - July.

**Varieties**

<table>
<thead>
<tr>
<th>SN</th>
<th>Variety</th>
<th>Character</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Alphonso</td>
<td><em>(Hafus)</em> Best export variety but susceptible to spongy tissue</td>
</tr>
<tr>
<td>2</td>
<td>Chausa</td>
<td>Sweetest but late maturing variety, grown in Northern India</td>
</tr>
<tr>
<td>3</td>
<td>Banganapalli</td>
<td>Most commercial variety of Andhra Pradesh</td>
</tr>
<tr>
<td>4</td>
<td>Bombay Green</td>
<td>Early maturity variety of north India, also known as Saroli</td>
</tr>
<tr>
<td>5</td>
<td>Kesar</td>
<td>It has good processing quality, popular in Gujarat</td>
</tr>
<tr>
<td>6</td>
<td>Langra</td>
<td>North Indian variety, has characteristic turpentine flavour</td>
</tr>
<tr>
<td>7</td>
<td>Niranjan</td>
<td>Off season variety (bear fruits in October)</td>
</tr>
<tr>
<td>8</td>
<td>Lal sindhuri</td>
<td>Powdery mildew resistant new variety of mango</td>
</tr>
<tr>
<td>9</td>
<td>Neelam</td>
<td>Ideal for long transport, two crops are taken in a year</td>
</tr>
<tr>
<td>10</td>
<td>Edward</td>
<td>Resistant to anthracnose</td>
</tr>
<tr>
<td>11</td>
<td>Fazli</td>
<td>Commonly grown in Bihar &amp; West Bengal</td>
</tr>
<tr>
<td>12</td>
<td>Banglaura</td>
<td>Known as totapuri, south Indian variety</td>
</tr>
</tbody>
</table>
Dashahari
Grown in UP, best medium ripening variety.

✨ Hybrid Varieties of Mango

<table>
<thead>
<tr>
<th>SN</th>
<th>Hybrid</th>
<th>Cross</th>
<th>Characters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Arka anmol</td>
<td>Alphonso x Janardan pasand (AJA)</td>
<td>Free from spongy tissue</td>
</tr>
<tr>
<td>2</td>
<td>Arka puneet</td>
<td>Alphonso x Banganpalli (ABA)</td>
<td>Free from spongy tissue</td>
</tr>
<tr>
<td>3</td>
<td>Arka aruna</td>
<td>Banganpalli x Alphonso (BAA)</td>
<td>Free from spongy tissue</td>
</tr>
<tr>
<td>4</td>
<td>Ratna</td>
<td>Neelam x Alphanso, (NAR)*</td>
<td>Sponge tissue disease resistant, developed from Kokan Krishividhyapeeth, Dhapoli, Maharashtra</td>
</tr>
<tr>
<td>5</td>
<td>Amrapali</td>
<td>Dasheri x Neelam (DNA)</td>
<td>Dwarf, good for kitchen garden, developed from IARI, New Delhi.</td>
</tr>
<tr>
<td>6</td>
<td>Sindhu</td>
<td>Ratna x Alphanso (RAS)</td>
<td>First seedless variety in world, developed from Kokan Krishividhyapeeth, Dhapoli</td>
</tr>
<tr>
<td>7</td>
<td>Mallika</td>
<td>Neelam x Dasheri (NDM)</td>
<td>Highest vitamin content, developed from IARI, New Delhi.</td>
</tr>
<tr>
<td>8</td>
<td>Sai sugandha</td>
<td>Totapuri x Kesar (TKS)</td>
<td>New hybrid variety of mango</td>
</tr>
<tr>
<td>9</td>
<td>Ambika</td>
<td>Amrapali x Janardan pasand (AJA)</td>
<td>Developed from CISH, Lucknow, UP. Skin colour dark red, Yield high</td>
</tr>
<tr>
<td>10</td>
<td>Other hybrids</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*(NAR) means: Neelam x Alphanso = Ratna

生理学的障碍

- **Black Tip** – 由于硼的缺乏。在开花前、开花期间和果实形成时喷洒硼酸有助于管理。
- **Spongy Tissue** – 由于土壤热对流。在Alphanso中是一个主要问题。
- **Leaf Scorching** – 由于钾的缺乏。喷洒硫酸钾有帮助。
• **Internal Necrosis** – Boron Deficiency. Application of borax helps

2. **BANANA (Kalpatharu)**

• India is the largest producer of banana in the world
• Propagated by sword suckers
• Banana gives one time fruits in life
• Most of the cultivated banana is **Triploid in nature**
• Diploid banana variety is: **Ladyfinger**
• Cut rhizomes are used for propagation is known as: **Peepers**
• Seedlessness in banana is controlled by spray of: 2, 4-D@ 25 ppm.
• Banana fruits can be stored at 13 °C temperature & 85-95% humidity for three weeks.

✧ **Varieties:**

• Dwarf cavandish
• Robusta
• Rasthali
• Poovan
• Honda
• Champa
• Nendran (Kerala and TN)

✧ **Disease:**

• Panama wilt
• Sigatoka leaf spot
• Bunchy top: Viral (BABU virus), transmitted by banana aphids.
• Moko disease: Bacteria
• Kokkan disease: Virus

✧ **Insect-pest:**
Rhizome weevil: It is monophagus pest of banana (JRF-09)

Aphids: vector of Bunchy top vims.

3. CITRUS FRUITS

(a) MANDARIN (Santra Orange)

- Most common among citrus fruits grown in India.
- Mandarins are highly susceptible to: Water logging.
- Mandarin, sweet orange, acid lime and grape fruit are: Highly polyembryonic.
- Citrus fruits have a special kind of fruit skin referred as: Leathery rind.

Diamond Varieties of mandarin:
- Laddu.
- Coorg: commercial variety in south India.
- Kinnow: Cross between King mandarin x Willow Leaf mandarin. Developed by H.B. Frost, USA -1935), It was first introduced in Punjab.

(b) SWEET ORANGE

- Preharvest fruit drop is common in citrus.
- It can be checked by spray of 2, 4-D @ 20 ppm.
- Ranpur lime is the best rootstock for mosambi.
- T' budding or Patch budding are most common methods for propagation of sweet orange.

Diamond Varieties
- Satgudi
- Mosambi
- Blood red
- Jaffa
- Pine apple
- Valencia
(c) KAGZI LIME

- Known as Acid line/sour lime.
- Acid lime is commonly propagated by seeds.
- Kagzi lime is the indicator plant for Tristeza (highly susceptible to this disease).
- Citrus canker is most serious disease of acid lime.

✧ Varieties of kagzi lime:
  - Chakradhar: Seedless variety of acid lime.
  - Pramalini: Good yielder
  - Mithachikna: sweet, juicy variety.
  - Sai Sarbati: Tolerant to tristeza and canker

✧ Diseases of citrus:
  - Gummosis
  - Bacterial canker
  - Tristeza

✧ Physiological Disorders
  - Granulation: Due to high temperature & R.H.
  - Exanthema: Copper deficiency.
  - Yellow leaf of citrus: MO deficiency.
  - Die back due to: Cu deficiency
  - Little leaf: Cu deficiency

4. PAPAYA

- Papaya is a: Polygamous plant
• It produces fruits throughout the year.
• It is a tropical fruit and more sensitive to frost.
• Yellow pigment in papaya: Caricaxanthin (RPSC, AO-09)
• Milk (lactic acid) obtained from unripe fruit of papaya: Papain
• In dioecious varieties of papaya: 10% male plants are planted
• Papaya is commercially propagated by: Seed
• Enzyme present in dried latex of papaya is: Pepsin
• Carpine obtained from papaya is utilized as: Diuretic and heart stimulant
• Frost is the most limiting factor in papaya in: North India
• Papaya is susceptible to: Water logging
• Most serious disease of papaya seedlings is: Damping off

✪ Varieties
• Pusa delicious
• Pusa majesty (nematode resistance)
• Coorg honey dew
• CO-3
• Taiwan (blood red coloured)
• Surya (RPSC, AAO-09)
• Sunrise solo (pink flesh)
• Pusa giant (used for canning and tooty fruit)
• Pusa Dwarf
• CO-5 (papain rich variety)
• Pant C-1
• Betty
• Hatras Gold
• Pusa nanha (extremely dwarf, suitable for HDP/pot garden)
Diseases

- Damping off/ stem rot
- Ring Spot
- Papaya leaf curl

5. POMEGRANATE

- It is highly drought tolerant among fruit crops.
- Origin of pomegranate probably: Iran (Persia)
- Pigment responsible for the red colour in pomegranate fruits: Anthocyanin.
- India has first position in the world with respect to area and production of pomegranate.
- In India, Maharashtra is the leading state in area and production followed by KR, AP, GJ, TN and RAJ.
- Juice of pomegranate is useful for patient suffering from leprosy.
- July-August is ideal time of planting in tropics.
- Amhe bahar is most commonly preferred by the growers because of high yield as compared to other flowering season.
- Wild type Anar is known: Daru
- Presently Bhagawa is the leading variety of pomegranate cultivation in India especially in Maharashtra

 Variety

<table>
<thead>
<tr>
<th>Variety</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jalore Seedless</td>
<td>Commonly grown in Rajasthan</td>
</tr>
<tr>
<td>Ganesh</td>
<td>Selection from Alandi, popular in Maharashtra</td>
</tr>
<tr>
<td>Kandhari</td>
<td>Medium Fruit</td>
</tr>
<tr>
<td>Arakta</td>
<td>Suitable for processing</td>
</tr>
<tr>
<td>Mridula</td>
<td>Cross from Ganesh x Gul a-Shah red</td>
</tr>
</tbody>
</table>
Ruby: It is hybrid from a 3 way cross from IIHR

Jyoti: It is cross between Bassein seedless x Dholka

Dolka: Grown in Gujarat

Bhagawa: Bright red colored, popular in Maharashtra, also known as Sinduri, Mastani, Jai Maharashtra

Amlidana: Ganesh x Nanha (new hybrid)

Wonderful: Originating from USA, fruit size large

✧ Insect-Pests
  ✧ Anar Butterfly – Serious pest of pomegranate. Managed by covering of fruits with butter paper.
  ✧ Fruit Fly
  ✧ Fruit sucking moth

✧ Physiological Disorders
  ✧ Fruit cracking due to deficiency of Calcium, Boron and Potassium
  ✧ Internal breakdown

6. BER
  ✧ Best time for pruning in ber is – April – May (Rajasthan)
  ✧ Ber crop is heavily pruned

✧ Varieties
  ✧ Dodhia – Resistant to fruit fly
  ✧ Gola
  ✧ Kaithali
  ✧ Seb
Mundia
Banarasi
Jogia
Meharun
Umran
Illaichi
Katha
Pathani

◇ Disease

◇ Powdery Mildew

7. GUAVA

◇ Practice of tacking winter crop of rainy season crop is known as crop regulation (to escape the attack of fruit flies).
◇ Stooling is the most common & cheapest method of guava propagation.
◇ Allahabad region of UP is known for best quality guava production.
◇ Guava is susceptible to soil acidity and alkalinity.
◇ Rainy season crop can be removed by spraying of urea at the peak flowering period.
◇ Wilt is serious problem in guava (common in Alkali soil)

◇ Varieties:

◇ Allahabad safeda
◇ Lucknow-49 (Sardar): It is selection from Allahabad safeda
◇ Chittidar (numerous red dots on skin)
◇ Harijha (popular in Bihar)
◇ Hafsi (Red fleshed guava)
- Behat coconut (seedless guava)
- Lalit (pink flesh fruit, dual purpose fruit)
- Kohir safed (Kohir x Allahabad safeda)
- Safed jam (Allahabad safeda x Kohir)
- Arka mridula (soft seeded, dwarf variety)
- Allahabad Safeda: famous variety of Allahabad
- Allahabad Surkha (fruit with deep pink flesh)
- Apple colour: (pink coloured)

- **Hybrid**
  - Hybrid – 45 = Allahabad Safeda x Sardar

- **Physiological Disorders**
  - Bronzing due to Zinc deficiency

8. GRAPES

- Ideal time of planting unrooted grape cuttings is: October.
- Rooted cuttings are planted in January-February.
- Grape is a deciduous crop.
- Propagated by hard wood cuttings.
- Thompson seedless with its clone occupies 55% area under grape cultivation
- Training system of grapes mostly adopted in India is: **Bower system**.

- Element that is universal deficient in grape is: Mg

- **Tartaric** acid is present in grape fruits
In northern India grapes are pruned till December-January

**Varieties**

<table>
<thead>
<tr>
<th>Varieties</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arka Trishna &amp; Soma</td>
<td>Wine purpose</td>
</tr>
<tr>
<td>Dilkhush</td>
<td></td>
</tr>
<tr>
<td>Arka Hans</td>
<td>White wine</td>
</tr>
<tr>
<td>Arka Kanchan</td>
<td>Late maturity variety</td>
</tr>
<tr>
<td>Thomson Seedless</td>
<td>Mostly grown variety</td>
</tr>
<tr>
<td>Muscat</td>
<td>Coloured seeded variety</td>
</tr>
<tr>
<td>Perlette</td>
<td>Mostly grown in Rajasthan</td>
</tr>
<tr>
<td>Anab-e-Shahi</td>
<td></td>
</tr>
</tbody>
</table>

**Diseases:**
- Downy mildew
- Powdery mildew

**Physiological disorder**
- Hen & Chicken disease is due to: Bo deficiency.
- Berry or Blossom drop in Grape: Improper pollination & fertilization.
- Pink berry formation is due to: High temp, common in Thompson seedless.
- Calyx end rot: Ca deficiency.

**9. COCONUT**
- India’s rank 3rd in coconut production after Indonesia and Philippines
• Kerala share in coconut production – 45%
• Chowgghat green dwarf and Pratap are coconut varieties

✧ Insect Pests
• Rhinoceros beetle: Fan like appearance of leaves.
• Red palm weevil
• Black headed caterpillar
• Coconut mite
VEGETABLE PRODUCTION

- India 2nd largest producer of vegetable after China
- **Truck garden** is very extensive method of vegetable cultivation.
- Green leafy vegetables are rich source of folic acid
- Major mineral present in fruit and vegetable is potassium.
- **Cucumber** is the non-climacteric vegetable fruits.
- **Quercetin** compound presence in onion and garlic is capable to protect against cancer and heart disease.
- Vitamin present in chilli is: Vitamin P
- The garlic flavor is due to sulphur compound: Di allyl di sulphide
- Flower colour of pointed gourd, bottle gourd and chilli is: White
- Flower colour of cruciferous is: Yellow
- Popular variety of pumpkin is: Pusa vishwas and Arka chandan
- **Arka harit and Pusa visesh** are varieties of bitter gourd
- **Pusa nasdar and Satputia** are the varieties of ridge gourd.
- **Pusa supria and Pusa chikni** are varieties of sponge gourd
- PBOG-I, Pusa manjari and Pusa maghdoot are the varieties of: Bottle gourd.
- Pusa suffaida and Pusa lal are the variety of: Sweet potato.
- RS-I and RZ-19 are varieties of cumin.
- Rcr-41 and UD-20 are the varieties of coriander.
- **Rmt-I, Rmt-141, Rajendra kranti** are varieties of: Fenugreek

1. TOMATO

- Origin of tomato: Peru
- Fruit of tomato is: Berry
- Red colour in tomato due to: Lycopine
- Popular variety of tomato: Pusa ruby, Arka vikas
- Major pest of tomato: Fruit borer
- In adverse conditions tomato crop is sprayed with: PCPA for higher fruit setting.
• **Punjab chhuhara** is a determinate variety of tomato

◊ **Varieties**

<table>
<thead>
<tr>
<th>Variety</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pusa ruby</td>
<td>Sioux x Improved Meerutti.</td>
</tr>
<tr>
<td>Pusa-120</td>
<td>Nematode resistant</td>
</tr>
<tr>
<td>Arka sourabh</td>
<td></td>
</tr>
<tr>
<td>Pusa Gaurav</td>
<td></td>
</tr>
<tr>
<td>Arka vikash</td>
<td></td>
</tr>
<tr>
<td>Hissar lalit</td>
<td>Nematode resistant</td>
</tr>
<tr>
<td>Pusa sheetal</td>
<td>Winter season</td>
</tr>
<tr>
<td>SL-120:</td>
<td>Nematode resistant</td>
</tr>
<tr>
<td>Roma</td>
<td>Suitable for transport and processing</td>
</tr>
<tr>
<td>Parker</td>
<td>Fruit borer resistant</td>
</tr>
<tr>
<td>Punjab Chhuhura and Roma</td>
<td>Suitable for processing</td>
</tr>
<tr>
<td>Flavr Savr</td>
<td>Developed through Biotechnology</td>
</tr>
</tbody>
</table>

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2. **BRINJAL**

• Pigment present is Anthocyanin

• Good source of – **Vitamin B**

◊ **Varieties**

• Pusa purple long (extra early maturity)

• Pant samrat (Phomopsis blight and bacterial wilt resistant)

• Azad kranti

• Black beauty(nematode resistant)

• Arka sheel, Arka nidhi

**Hybrid Varieties**
- Pant Rituraj
- Pusa bindu
- Pusa upkar
- Pusa Bhairav
- Arka Navneet
- Arka Neelkantha
- Annamalai
- Arka Keshav

**Diseases**
- Little leaf of brinjal is due to Phytoplasm
- Transmitted by leaf hoppers

3. CHILLI
- Red colour of chilli is due to: *Capsanthin*
- Pungency of chilli is due to: *Capsaicin or capsicutin*
- Major pest of chilli is: Thrips
- India is a major producer, consumer and exporter of chilli in the world
  - *Andhra Pradesh* is pioneer in chilli production
  - Capsicum annum is also known as sweet pepper

**Varieties**
- California wonder
- Arka mohini
- Andhra jyoti
- Pusa jwala
- Jwalamukhi (suitable for HDP)
- Arka lohit (powdery mildew tolerant)
4. CABBAGE

- India rank 3rd in cabbage production.
- Cabbage has anticancer property due to presence of Indole-3 carbinol.
- Fruit of cabbage is known as: Head
- Fruit type of cabbage: **Siliqua**.

**Varieties**

- Golden Acre
- Copenhagen Market
- Pride of India
- Pusa drumhead (Hybrid)
- Pusa mukta (Hybrid)
- Pusa sambandh

5. CAULIFLOWER

- **Blanching** is mostly done in early varieties of cauliflower to protect curd from attaining yellow color after their direct expose to sun and to arrest enzymatic activity.
- Fruit of cauliflower is known as: **Curd**
Three season varieties are available in: **Cauliflower**

- **Scooping**: removal of central portion of curd for earlier initiation of flower stalk in cauliflower
- **Pusa himjyoti** and **Pusa snowball** have self-blanced habit.

6. **ONION**

- Rich source of: **Vitamin B**.
- Pollination of onion is chiefly mediated by: **Honey bees**
- Pungency in onion is due to: **Allyl propyl di sulphide**.
- **Onion** is a cool season crop
- The colour of outer skin of onion is due to: **Quecertain**.
- Onion is very useful in: **Sun stroke**.
- **Bolting**/stem elongation in onion is due to: Low temperature
- In onion & garlic: Purple blotch is due to: **Alternariaporii**
- **Lassalgoan** in Maharashtra is the biggest onion market in India.
- **Cate chol** is a phenolic factor present in onion has antifungal property.

- **Varieties in Rabi season:**
  - Pusa red
  - Nasik red
  - Patna red
  - Udaipur 101, 102, 103
  - Pusa ratnar
  - N-53
  - Kalyanpur red round
  - Pusa madhavi
  - Arka bindu
Varieties in Kharif season
- Arka Kalyan
- Agrifound dark red
- N-53
- Arka Pragati

7. RADISH (Root Crop)
- Mustard saw fly and Painted bug are the pests of radish
- Roots of radish prepared for seed production is known as stackling
- Brown heart in Radish is due to Boron deficiency

Varieties
- Arka Nishant
- Pusa chetki
- White icicle
- Japanese White
- Pusa safed
- Scarlet Globe
- Pusa Rashmi
- Pusa Himani
- Round cherry belle – Red colored variety of radish

8. CARROT (Root Crop)
- Annual crop for root production
- Biennial for flowering and fruit set
- Kanji (beverage is prepared from black carrot)
- Forking of carrot is due to Hard pan of soil
9. BOTTLE GOURD (lauki)

- Varieties
  - Pusa Summer prolific long
  - Pusa summer prolific round
  - PBOG – 1
  - Samrat
  - Pusa manjari
  - Punjab Komal
  - Arka bahar
  - Pusa meghdoot

10. PEA

- Rich source of protein
- Uttarakhand is the highest producer of pea
- Most popular canned vegetable
- Wrinkle seeded varieties are sweeter than smooth seeded
♀ Varieties
  ◇ Azad P-1
  ◇ Jawahar Mator – 1
  ◇ Boneville
  ◇ Arkel
  ◇ Sylvia
  ◇ Arka Ajit
  ◇ Harbhajan
  ◇ Hissar Harit -1
  ◇ Rachna
  ◇ Swarna rekha
  ◇ Meteor

♀ Principles of Preservation
  1. Canning :
     ▪ Fruits can be processed at temperature 100 °C
     ▪ Vegetables can be processed at temperature of 115 -121 °C
  2. Pasteurization :
     ▪ Heating of fruits and vegetable juice at 85-90 °C for 30 minutes
     ▪ It kills only harmful microbes.
  3. Sterilization:
     ▪ Heating of fruits and vegetables above 100 °C
     ▪ It kills both beneficial and harmful microbes.
  4. Freezing:
     ▪ Cooler storage: 15 °C
     ▪ Refrigeration or chilling: 0-5 °C
  5. Cryo preservation:
     ▪ Preserve in liquid nitrogen at -196 °C.
6. **Drying**: Removal of moisture by applying heat is called drying. Raisins (Kismis).

7. **Preservation through osmosis**:
   - High concentration of sugar: e.g. Jam (68 % sugar), Agra ka petha.
   - Salt preservation: Salt conc. 15-25 % act as preservatives e.g. in pickles: 15%

8. **Preservation by chemicals**:
   - KMS (Potassium Meta bi Sulphite): @ 350-500 ppm or 0.05%.
     - Sulphur di oxide (SO2) is responsible for preservation.
     - It used against colorless fruit juices/pulp.
   - Sodium benzoate: @ 700 ppm/0.07%.
     - Benzoic acid is responsible for preservation.
     - Used in colored fruit product (e.g. Tomato products).

9. **Fermentation**: grape wine (alcohol 7-20%) is oldest example of fermented beverage.

10. **Asepsis**: prevent entry of microbes.

11. **Oxidation** can be checked by antioxidants (Ascorbic acid /vit. C)

12. **Checking of enzymatic spoiling**: Blanching in vegetables

13. **Blanching**: keeping vegetables in boiling water for 2 minutes followed by cooling