

**Can you recall?**

1. Any garden plant that you have seen before.
2. Why the fruits are eaten by human being since ancient time?

14.1 Definition and branches of horticulture**14.1.1 Definition :**

The word Horticulture is derived from the Latin words *hortus* and *colere* meaning garden and to cultivate, respectively.

Horticulture is a part of plant agriculture which is concerned with cultivation of garden crops.

Garden crops traditionally include fruits, vegetables, ornamentals, spices, plantation crops, flowering plants, medicinal plants and aromatic plants.

Horticulture can be defined as the branch of agriculture concerned with intensively cultured plants directly used by people for food, medicinal purpose or aesthetic gratification.

14.1.2 Branches of horticulture

Horticulture is a wide field which includes numerous crops (groups) having great diversity.

Following are the branches of Horticulture

- (1) **Pomology** - Study of fruits (Pomam means fruit and logy means science)
- (2) **Olericulture** - Study of vegetables (*Oleries* means pot herb)
- (3) **Floriculture** - Study of flowers, ornamental plants and landscaping.

In addition the following are the classes of horticulture -

- (1) **Plantation crops** - Study of crops grown on large area for commercial uses.

- (2) **Spice crops** - Study of crops grown for their spicy taste and flavour. (used in food preparations)

- (3) **Medicinal and aromatic Plants** - Study of plants having medicinal property.

- (4) **Post harvest technology** - Deals with post harvest handling, grading, packaging, storage, processing, value addition, marketing, etc. of horticultural crops.

- (5) **Plant propagation** - Deals with propagation of horticultural crops and their nursery.

Landscape gardening is an art of beautifying a piece of land with garden design, methods and plant material

**Remember this**

India is the second largest producer of fruits after Brazil.

India ranks second in vegetable production after China.

14.2 Importance of horticulture

- (1) **Economic** - Horticultural crops especially fruits, vegetables and plantation crops are more and prolific yielders. Spices, medicinal, aromatic and floricultural crops are high value crops. These crops fetch more price in the market. These crops yield more per unit area and are grown with different objectives on different fields. Horticultural crops are useful for improving economic, health and nutritional status of the farmer.

- (2) **Employment** - These crops are labour intensive. Horticultural crops are delicate and tender in nature hence they require utmost care at each stage of production which increases requirement of man days.

Area	Man days for cereals per year	Man days for fruit production per year
1 hectare	143	860 for fruits 1000 to 2520 for grape and banana



Always remember

Sr. no.	Nutritional item	Rich source
1	Vitamin A	Mango, Papaya, Carrot, Drumstick leaves
2	Vitamin B	Cashew nut, Walnut, Colocasia leaves
3	Vitamin C	Aonla, Lime, Guava, Corriander leaves
4	Carbohydrates	Banana, Dates, Sweet Potato, Potato,
5	Protein	Almond, Pea, Cowpea, Beans
6	Fat	Walnut, Avocado
7	Fibre	Amaranth, leafy vegetables
8	Calcium	Litchi, Curry leaves, Fenugreek, Cucumber
9	Phosphorus	Cashew nut, Walnut
10	Iron	Karonda, Dates, Spinach

(3) **Industrial** - Horticultural plants supply raw material to the industry directly or indirectly. A vast industrial development is observed in area growing horticultural crops. Manufacturing of processed fruit products, edibles, cosmetics, medicines has shown improvement in recent years in India.

(4) **Religious and sacred value** - Horticultural plants have religious value to their leaves, flowers, fruits, roots, plants, etc. and are used in many religious functions.

(5) **Food and nutrition** - As a source of carbohydrates, proteins, fats, fibre, vitamins and minerals, some horticultural crops have high food value. These act as alternative for the conventional food. Further processed product of these crops show high nutritional value. Consumption of adequate amount of fruits and vegetables helps in maintaining health, vigour and resistance of human body.

14.3 Scope for horticulture :

Areas in horticulture having scope for future prospects-

1. **Hi-tech Horticulture** : Technology for intensive production system, including ethnic and exotic crops.
2. **Microirrigation** : For saving water and giving enough water there by bringing more area under cultivation.
3. **Use of plastic** : For cultivation practices (Poly house, mulching) and post harvest handling.
4. **Protected cultivation** : For production of high value crops under controlled conditions.
5. **Precision farming** : Emphasis on maximum precision in production, minimizing wastage of inputs and resources.
6. **High density planting** : High yield from same piece of land.
7. **Integrated nutrient management** : Use of organic and inorganic sources enabling better availability of nutrients in the soil.
8. **Integrated pest management** : Use of different methods in of pest control combination so as to minimize use of hazardous chemicals.

- 9. Mechanization :** Reduce agriculture labour, fast field operations, easily handling huge area.
- 10. Organic farming :** Increasing demand for safe and natural food providing natural inputs.
- 11. Contract farming :** Economic liberalization process leads to efficient changes in marketing strategies of agriculture produce.
- 12. Export - Import trade :** Showing continuous growth in export of horticultural produce and import of certain commodities better assured market for agri-horti produces.

Table : 14.1 Comparison of Area, Production and Productivity of horticultural crops

Crops	Particulars	1991-92	2016-17
Fruits	Area in 000 ha	2874	6480
	Production in 000 MT	28632	92846
	Productivity in MT/ ha	9.96	14.33
Vegetables	Area in 000 ha	5593	10290
	Production in 000 MT	58532	175008
	Productivity in MT/ ha	10.47	17.01
Flowers and Aromatic	Area in 000 ha	106	943
	Production in 000 MT	535	3277
	Productivity in MT/ ha	5.05	3.48
Plantation crops	Area in 000 ha	2298	3677
	Production in 000 MT	7498	16897
	Productivity in MT/ ha	3.26	4.59

Spices	Area in 000 ha	2005	3535
	Production in 000 MT	1900	7077
	Productivity in MT/ ha	0.95	2.002
Total	Area in 000 ha	12770	24925
	Production in 000 MT	96562	295164
	Productivity in MT/ ha	7.56	11.84

Information from NHB data, (2018)

14.4 Planning and layout of orchard :

14.4.1 Selection of site: Selection of site is of paramount importance in horticultural crops. Mistake committed at the initial stage is difficult to rectify at the latter stage.

Factors to be considered while selecting suitable site for growing horticultural crops are,

1. The site should be in a favorable fruit region.
2. The site should be free from stagnation of water during rainy season.
3. The climate should be suitable for the fruit crop chosen.
4. Sufficient supply of good quality irrigation water throughout the year.
5. Suitability of soil, its fertility, the nature of sub soil and depth.
6. Along with irrigation facilities proper drainage arrangement should be made.
7. Supply of electricity.
8. Nearness to the city or market so that other special problems can be solved. Otherwise site should be connected with good road.
9. Nearness to the horticultural industry already established so that grower can get technical guidance and co-operation
10. Availability of skilled labour at cheaper rate.
11. Nearness to the processing industries and cold storage facilities.

After selecting a site, taking into consideration, the above criteria, land is levelled, brought to fine tilth. Different plots are made as per the layout, sufficient space given for roads and path, irrigation channels are prepared, provision of adequate drainage and wind breaks are made around the orchard.



Keep in mind

- a. Careful plan of orchard is necessary for utmost economic and efficient management
- b. Attractiveness
- c. Economic use of labour
- d. Location of roads, drainage, irrigation channels, path, hedges, and wind breaks.

14.4.2 Layout of orchard

While preparing plan of a big orchard, following points are highly essential.

1. Optimum spacing to grow optimum number of trees per unit area.
2. Farm buildings should be at entrance of the orchard or centre or at high level for thorough supervision.
3. Do not plant large trees with small trees.
4. Planting fruit trees according to their soil requirements.
5. Irrigated trees should be near the source of water.
6. Evergreen trees should be at front and deciduous crops should be behind.
7. Trees having big canopy should be on the back side and trees with less canopy should be in front.
8. Fruits attacked by birds and animals should be close to the watchman shed.
9. Pollinator should be provided to self incompatible fruit trees e.g. ber, mango, etc.
10. Those crops require equal spacing should be grouped in one blocks.



Remember this

Orcharding refers to growing of fruit plants in an orderly manner and maintain them for successive economic returns.

Garden refers to fruit farm where sophisticated agro techniques are employed for commercial cultivation e.g. Grape garden.

14.4.3 Development of new orchard

Fencing

Fencing is essential to prevent destruction of the trees from stray cattle and also to protect the orchard from stress passing. It is necessary to provide some kind of fencing on all sides of the garden and this should be done preferably before planting the fruit trees. Fencing helps to mark the borders of the orchard. Fences may be live or can be made using thorny and dead bushes, but these are not satisfactory and require frequent repair and replacement (e.g. chilar, sagargota) Barbed wire fencing is very good but its initial cost is rather high.

Types of fencing

There are two types of fencing used for protection of orchard.

1. Live fencing 2. Non-living fencing

1. Live fencing - The cheap and best protection is planting of live fence. Some of the plants are very useful as live fence.

1. *Prosopis juliflora* (vilayati Babhul) and *Caesalpinia sepiaria* (Chillar):- These can be established in May - June. The seed should be sown in a trench 30 cm wide and 22.8 cm deep all around the orchard boundary.
2. *Carissa carandas* (Karonda): This makes an effective dense hedge. In addition it bears fruits if not pruned too closely.

Other plants used for live fence are *Lantena camera* (Ghaneri), cacti, Coenel, Dedonia, mendhi, casurina (Khadsarni, sher), Adulsa, Shendri, sagargota, etc.

2. Non living fencing

- (a) Barbed wire (b) Compound wall
- (c) Grill. (d) Electrical fencing
- (e) Solar wire fencing

In solar wire minute current is developed from solar cells or battery rays. Due to this current minimum shock will be created when stray cattle and human touch it.

14.4.4 Planting Systems

The layout of an orchard is a very important operation. Laying out the orchard begins with the marking of a base line which is usually taken parallel to fix structure. First line should be at half the spacing to be given between the trees. At both ends of the base line right angles are created by following the simple carpenters meter system. After the formation of these three lines. It is easy to fix the boundary of the orchard.

Different methods of planting an orchard:

- 1. Square system** - The field is divided into squares as per spacing. In this case a sapling is planted on each vertex of a square whatever may be the planting distance. This plan is commonly followed. It is easy to layout. Convenient for inter cropping and cultivation is possible in two directions e.g. mango (10×10 m), banana (1.25×1.25 m). Each plant gets equal area for growth and drip.

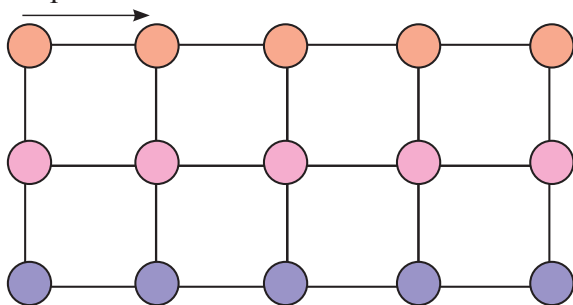


Fig. 14.1 : Square system

- 2. Rectangular System** - In this system, the field is divided into rectangles as per spacing. Saplings are planted at each vertex of the rectangle. E.g. Grape (3×2 m) Increased spacing in rows is useful for mechanical cultivation between rows.

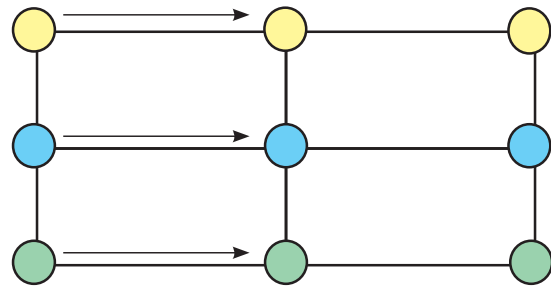


Fig. 14.2 : Rectangular system

- 3. Hexagonal system** - In this method the saplings are planted at each vertex of equilateral triangle. In this way six trees form hexagon with the seventh tree in the centre. It is also called as septuple. This plan can be usually employed where land is expensive and very fertile with good available water supply. The trees are equally spaced from each other but difficult to layout. Intercultivation is difficult in this system. In this layout 15% more plants are accommodated than the square system.

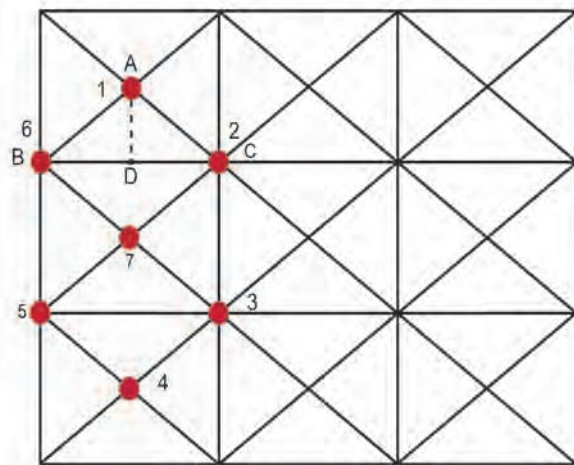


Fig. 14.3 : Hexagonal system

- 4. Triangular System** - In this system the saplings are planted as in the square system but the plants in the 2nd, 4th, 6th and such other alternate rows are planted mid way between the 1st, 3rd, 5th and other alternate rows. This system has no special advantages over the square system except providing more open space for the trees and for inter crops. It is difficult for labour and cultivation. This system is useful for plantation on hill slopes.

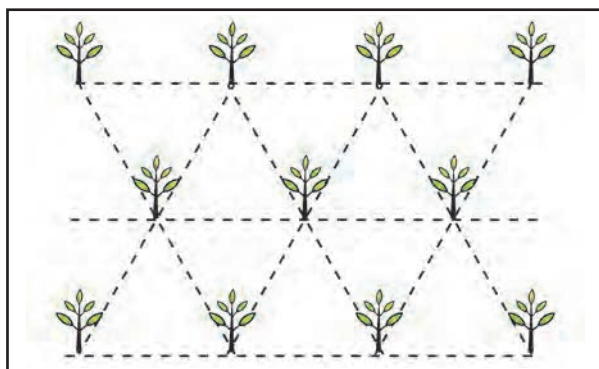


Fig. 14.4 : Triangular system

- 5. Quincunx system** - It is differing from square system by planting an additional sapling in the centre of each square of permanent trees. The central tree is usually the filler tree which is kept only for a shorter period.

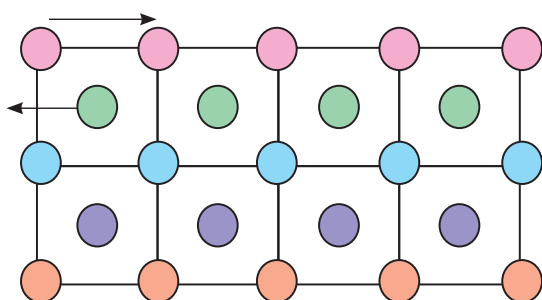


Fig. 14.5 : Quincunx system

- 6. Contour system** - It is only followed on hills with high slopes. Contour line is an imaginary line drawn connecting points on same level on sloppy land. In this case the trees are planted along a uniform slope and usually at right angle to the slope with the idea of reducing loss of soil due to soil erosion. It is followed just as in case of square system. The marking should be done from the lowest level to the top.

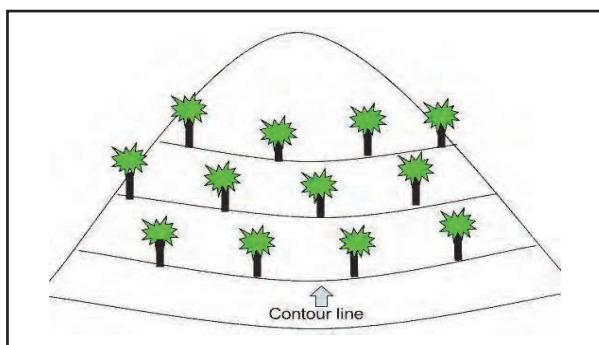


Fig. 14.6 : Contour system

Table : 14.2 No. of trees in various planting systems

Planting distance	No of trees / ha in system		
	Square	Hexagonal	Quincunx
3 × 3 mt	1085	1250	2170
5 × 5 mt	480	555	960
7 × 7 mt	225	255	450
12 × 12 mt	65	75	130

Formula for calculating number of plants

No. of Plants =

Total area in Sq. M.

Plant to plant distance in m × Row to row distance in m

Calculation of number of plants in hexagonal system (From fig. 14.3)

Plant to plant distance = 10m

Row to row distance to be calculated

ABC is an equilateral triangle

BC = AB = AC = 10m

Draw a perpendicular line AD to BC which divides it in to two halves.

It means BD = DC = 5 m

Now in triangle ABC

$$AC^2 = AD^2 + DC^2$$

$$\text{i.e. } AD^2 = AC^2 - DC^2$$

$$= 10^2 - 5^2$$

$$= 100 - 25$$

$$= 75$$

$$AD = \sqrt{75}$$

$$= 8.66$$

Thus row to row distance is 8.66

No. of Plants =

Total area in Sq. M.

Plant to plant distance in M. × Row to row distance in M.

$$= \frac{10000}{10 \times 8.66}$$

$$= 115 \text{ approximately}$$

Wind breaks :

Definition :

The wind break means close planting of tall growing trees all around the orchard preferably at south west direction of plantations.

Importance

Fruit orchards usually cause heavy losses when exposed to strong wind. Heavy wind increases the losses of moisture both by increasing transpiration and surface evaporation. The high winds also cause the damage to fruit trees by breaking of branches, destruction of blooms, dropping of immature fruits and erosion of surface soil. The fruit yield is also reduced on the exposed orchards firstly due to drying of stigmatic fluid and secondly due to reduced activities of pollinating insects. The growth and yield in protected orchard is definitely better than the exposed orchard. Hence, establishment of a tall growing wind break is necessary to protect the orchard.

Selection of wind breaks

While selection of wind breaks more importance should be given to the height than the thickness. Wind break will give full protection to distance of 4-5 times the height of trees. The wind breaks should be erect and tall, quick growing, hardy and drought resistant, occupy less space as far as possible. They should be mechanically strong and dense to resist maximum wind velocity.

Planting distance

Proper spacing of fruit trees is one of the most important considerations in successful fruit cultivation. Spacing depends upon the fertility of the soil and nature of growing of the trees. Improper spacing of trees may result in the poor quality of fruits and incidence of pest and diseases. Too much close spacing will result in poor growth of fruit trees and inferior quality of fruits because of lack of sunlight. Very wide spacing will result in waste of valuable land.

Table 14.2 : Planting distance for the fruit trees.

Sr. No.	Fruit trees	Spacing (meter)
1.	Mango	10 × 10
2.	Apple	7.5 × 7.5
3.	Orange	6 × 6
4.	Banana	2.4 × 2.4
5.	Guava	6.8 × 6.9
6.	Pomegranate	3.6 × 2.6
7.	Pineapple	0.45 - 0.60 × 0.45 - 0.60
8.	Awala	8 × 8
9.	Chikoo	8 × 8
10.	Papaya	2.25 × 2.25
11.	Coconut	7.5 × 9
12.	Ber	6 × 6
13.	Strawberry	0.6 × 0.3
14.	Jamun	10 × 10
15.	Tamarind	10 × 10

Planting material

Proper selection of planting material is very important for successful fruit growing. The planting material should be genuine, true to type variety, healthy, free from pest and diseases, insects and virus. It is always advisable to procure the planting material from reliable source like government nurseries, agricultural university nurseries.

While purchasing planting material following consideration should be taken -

- (1) The planting material should be true to type and variety. The planting material should have been prepared from healthy mother plant with high productivity record.
- (2) The graft and / or bud joint with stock should be strong and well developed.
- (3) The plant should be budded or grafted on recommended rootstock.

Preparation of pits and planting

Preparation of land

Since the fruit trees remained in the field for a very long duration, the land and plots

should undergo repeated ploughing, harrowing and levelling. Before digging pits green manuring crops should be grown and buried in the soil to enrich the orchard soil and to improve the physical condition of soil.

Digging pits

Having decided to give optimum spacing the plot is laid out with measuring tape, stakes, etc. The pits are taken in advance before planting. The size of pit is decided according to fruit tree and soil type. In poor soils larger pits are taken for larger trees, smaller pits are dug for dwarf trees and in fertile soils smaller pits are generally taken. The size of pit varies from 0.5 cubic meter to one cubic meter. While digging pit upper soil is kept aside. The pits are dug out in advance and are exposed to sun for a week or so. The pits are filled with top soil, farmyard manure or compost, bone meal. Add insecticide powder in soil to prevent attack by pest.

Planting

Having procured genuine and healthy planting material, it should be planted during monsoon where rainfall is not heavy. In region like Konkan, where rainfall is very heavy, planting should be undertaken after rains are over. The planting should be done on cloudy day preferably in the afternoon.

The plants should be carefully removed from polythene bag or earthen pot without disturbing root system and put in a small hole in the pit and covered with soil. Before planting damaged roots should be cut and then plant the seedling. The planting board is used for planting at the right position. After planting press the soil gently. Water the plant as soon as possible if necessary.

14.5 Training and pruning

Training and pruning are important orchard operations

These processes form an indispensable operation having direct bearing on growth and vigor of plants. These processes also have effect

on yield and quality of Fruits. Proper training and pruning of the plants sustain heavy crop load and produces good quality harvest. Plants develop strong framework and they are free from drooping branches, narrow crotch angle, water sprout, root and crown suckers.

14.5.1 Training : It refers to removal of part of plant to develop a proper shape of plant capable of bearing heavy crop load. It is related to shape and size of a plant.

Objectives of training

- (1) To develop strong framework.
- (2) To control and regulate shape.
- (3) To maintain better crotch angle.

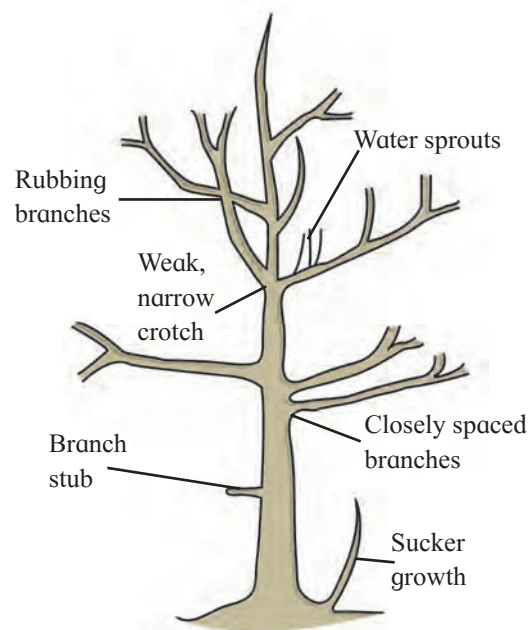


Fig. 14.7 : Training

- (4) To develop balance between vegetative and reproductive branches.
- (5) To facilitate interception of sunlight.
- (6) To remove water sprouts.

Principles of training

- (1) Started from very beginning of plant growth.
- (2) Most are trained in single stem system. Pomegranate, fig and custard apple are

trained by multi-stem training system as they are prone to insect attack.

- (3) In some plants terminal bud is removed to facilitate emergence of side shoots.
- (4) Branches with narrower crotch angle are discarded.
- (5) Remove water sprouts and drooping branches.

According to the height of the tree, the training is grouped in two ways.

(1) High head

In this type the main branches are encouraged about one meter or higher up from the ground level. In this case cultural operations with animal or mechanically drawn implements can be carried out very easily. In the tropical climate the practice is not followed generally as the sunscald and wind may damage the trees. The fruit bearing area on the plants also develops late and it bears fruits slowly.

(2) Low head

In this case the main branches forming the foundation frame work of the tree are managed on the trunk at a low height. Low headed trees come in bearing earlier and this type of practice is now more popular. In this method the plants can resist stormy winds more effectively and the other cultural practices can be done very easily.

Systems of Training

1. Central Leader
2. Open Centre
3. Modified Leader

1. Central Leader

In this system the main trunk grows undisturbed. As the growth of the branches is vigorous and rapid on the main trunk, the tree develops a close centre and grows to greater height. The side branches remain more or less stunted and as the result they would be low in vigour and productivity.

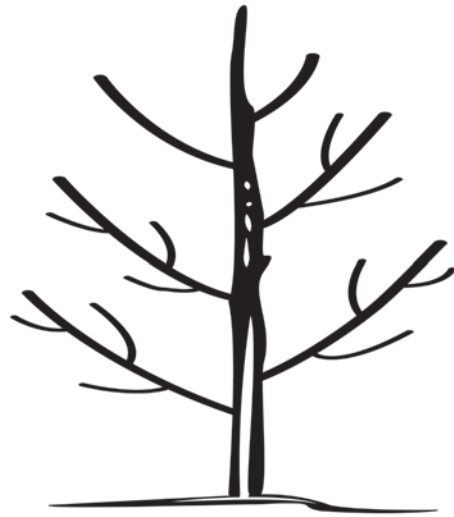


Fig. 14.8 : Central Leader

Advantage

1. Development of strong crotches due to interlacing of fiber at the junction of the limb and the trunk.
2. Strong frame work.

Disadvantages

1. Shading of the interior part of the tree.
2. Weakening of central leader due to shading reduces life of the tree.

2. Open Centre

In this system the main stem is allowed to grow only up to a certain height by heading it within a year of planting. All the subsequent vegetative growth is promoted by lateral branches. This results in low head. Bulk crop is borne closer to the ground.



Fig. 14.9 : Open Centre

Advantages

1. Better light penetration for the fruiting in inner branches.
2. Development of a low headed tree.
3. Trees are more fruitful and greatly facilitate the operations like pruning, thinning, spraying and harvesting.

Disadvantages

1. Tree becomes weak because of crowded crotches.
2. Heavy bearing causes breaking of the tree.
3. In high light intensity area trees suffers from severe sunscald and sunburn injuries.

3. Modified leader system

It is the combination of the central leader and open centre. First the central leader is allowed to grow and then is cut back not allowing it to become dominant. Selected laterals are allowed to grow and remaining laterals are removed to obtain proper orientation.



Fig. 14.10 : Modified Leader

Advantages

Most desirable in many trees because.

1. Low and well spaced laterals
2. Well distributed fruiting area.
3. Better light penetration.

4. Strong framework.
5. Easy cultural operations.

14.5.2 Pruning

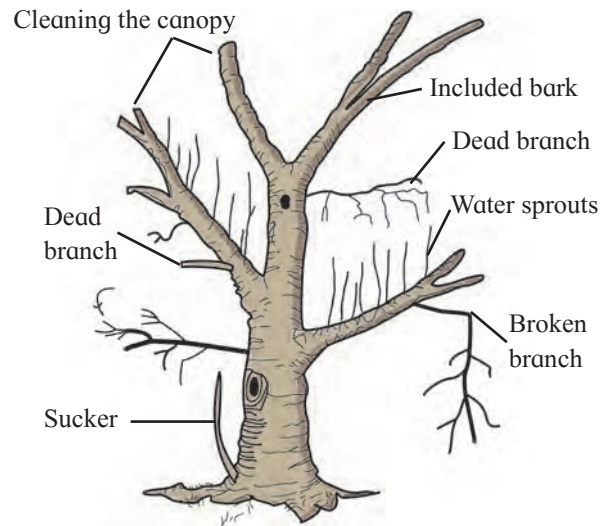


Fig. 14.11 : Pruning

Pruning is an important horticultural practice and its skill is very essential to the grower since the mistake in pruning may result more harm than good rewards.

Pruning is removal of a part of a plant like root, leaf, flower branch, vine or fruit to obtain good and qualitative yield. It is related to better harvesting with good quality fruits.

Definition

According to Gardener, pruning may be defined as “An art and science of cutting away a portion of plant to improve quality of the produce, or to heal, repair the injury”. The parts more commonly removed are branches or leaves or both.

The extent and intensity of pruning of any tree varies from year to year depending on the growth of the tree, its bearing and season.

Objectives

- (1) To control flowering and fruiting
- (2) To augment production in plants which bears on new shoots
- (3) To obtain regular bearing
- (4) To remove diseased, damaged, insect infested and water shoots

- (5) To thin out flowers and fruits
- (6) To ensure access of sunlight to bearing shoots
- (7) To invigorate the plants
- (8) To have a balance between vegetative and reproductive growth

Principles of pruning

- (1) Remove all water sprouts
- (2) If the shoot is to be removed completely it should be removed from the base
- (3) Avoid bark injury
- (4) Pruning should be completed well advance of flowering season
- (5) In deciduous plants pruning should be done in advance of winter to avoid low temperature injury.
- (6) Apply Bordeaux paste immediately
- (7) Crowded, diseased, damaged and insect infested shoots should be removed.

Methods of Pruning

1. **Thinning out** - This refers to the removal of the branches entirely from the base leaving no stubs.
2. **Heading back** - This refers to cutting of main stem or a few of the branches leaving a basal portion. This method is often followed for hedges, ornamental shrubs, first dormant and October pruning in grapes.

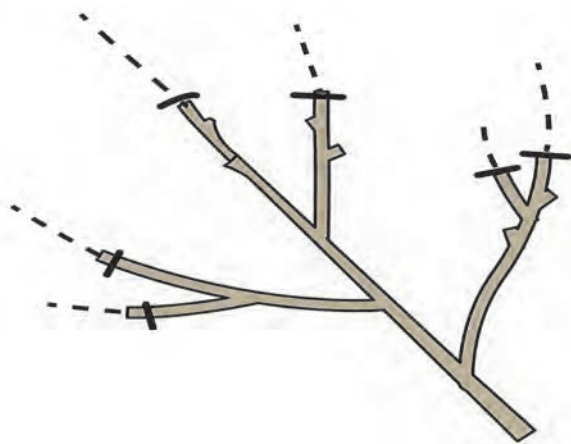


Fig. 14.12 A : Thinning out

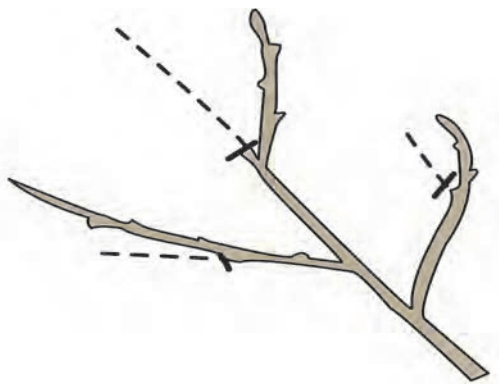


Fig. 14.12 B: Heading back



Use your brain

Find out purpose behind Frame pruning, Maintenance pruning, Renewal pruning.

3. **Disbudding** - The young buds are nipped with giving them no chance to sprout. The bud may be either vegetative or reproductive. This is practiced regularly in flowering plants to make the terminal bud to give a bigger flower.
4. **Pinching and topping** - This refers to the removal of the top of the shoot along with a view to stimulate the lateral growth.

Time and extent of pruning

The time of the pruning in different plant mainly depends upon their dormant and flowering seasons. The best time for pruning in case of the deciduous trees is at the end of the dormant season i.e. about a month before the commencement of flowering.

The extent of pruning to be adopted for a particular crop depends on its growing and fruiting habit, as it directly affect the nutritive condition within the tree and consequently affects the fruit formation. It also increases the size, shape and quality of fruit. Pruning is to be carried out in the month of May. Excess pruning reduces quality of fruits.

14.6 Special horticultural operations

14.6.1 High Density Planting (HDP)

Maximization of production should be the ultimate objective in the fruit cultivation. This

can be achieved by many ways. Increasing number of plants per unit area by adjusting the planting distance and method of planting is one of the ways.

Definition

Planting of fruit trees, closer than their normal spacing and making the plant population dense per unit area is known as high density planting.

Increased plant population may affect the growth and production due to over-crowding, shade effect and intermingling of branches of trees.

This can be avoided by

- (1) Controlling the size of the plant.
- (2) By adjusting the planting distance and method.

Size of plant is controlled by regular pruning or by using dwarfing root stocks. E.g. Vhallai - columban in mango, trifoliate orange in citrus.

In some plants, to avoid over shading the planting density is so arranged that it should not affect the root and shoot balance and should permit better light penetration. In banana, normal planting distance is $1.75 \text{ m} \times 1.75 \text{ m}$. In high density planting, it is planted at a distance of $1.25 \text{ m} \times 1.25 \text{ m}$.

In high density planting, there is competition for nutrients and water amongst the plants and hence yield of individual plant is reduced, yield per unit area is also hampered but it can be corrected by adopting proper agro horticultural practices.

Advantages

- (a) More plants per unit area hence yield increases.
- (b) Better utilization of land.
- (c) Production of marketable produce.

Effect on Growth and Yield

- (a) Due to less spacing the growth is erect.
- (b) Over crowding of branches causes fruit drop and infection of pest and diseases.
- (c) The yield is more as compare to normal spacing because plant population is increased.

14.6.2 Bahar Treatment

Bahar treatment is nothing but withholding water for 4-6 weeks prior to flowering with a view to give rest to the tree. The principle involved is, by giving rest to the tree or checking its growth, more carbohydrates are accumulated in the plant body which led to a profuse differentiation of buds and flowers.

This practice is followed in trees like mosambi, santra, guava, pomegranate, etc. in Maharashtra and in south India. Most of the orchards of these crops are planted on medium to deep black cotton soils which have very good water retention capacity. The climatic conditions in our state are such that there is no much more distinction between winter and summer season temperatures. As a result of which plant remains in the active growth throughout the year and refuses to produce flower abundantly, affecting the quality and total yield of crop. Therefore bahar treatment is necessary in these crops.

Method

Bahar treatment consists of withholding the irrigation water prior to flowering. In heavy soils 55-60 days water stress is given where - as in light soils it is of 40 to 45 days. Light ploughing or digging in the orchard is done before treatment. During water stress period plant stops growth, leaves turn pale green or slightly yellow. Over stress is dangerous.

When the stipulated period of water stress is over, basins are prepared, plants are manured at recommended doses of manures and irrigation is provided step by step. The first irrigation must be light one.

There are three types of bahar treatment
1. Mrig bahar 2. Hast bahar 3. Ambe bahar

1. Mrig bahar

- (i) Withholding of water is done in April-May and flowering occurs in June-July.
- (ii) Useful in our region because water withholding is done in summer season which is beneficial.

- (iii) Fruit develops after rainy season thus fruit fly attack is avoided.
- (iv) Dry and bright sunshine during ripening period enhances colour and the quality of the fruit.
- (v) In case of santra in North India mrig bahar is not followed and hence fruits from Maharashtra fetches good price.

2. **Hast bahar**

- (i) Withholdings of water is done in August and flowering occurs in Sept - October.
- (ii) Not practiced in Maharashtra

3. **Ambe bahar**

- (i) Withholding of water is done in November-December. flowering is in January - February.
- (ii) Fruit development is during summer. Not possible in Maharashtra as farmers face water scarcity in summer.
- (iii) Fruits are fairly attacked by the fruit flies, sucking moth during rainy season in Maharashtra
- (iv) In our region, fruit ripen in rainy season which affect the colour and quality of the fruit.

The choice of bahar depends upon

1. Availability of water.
2. Quality of fruits.
3. Attack of insects pest and diseases.
4. Availability of market and market prices.

14.6.3 Bending

Bending is generally followed in erect growing varieties of guava to increase yield. In such varieties branches and shoot grow erect and the buds situated on the top of the branch sprout which bear flower and fruits. The buds on the lower side of the branches remain dormant and fail to sprout. So the fruit bearing area becomes less and naturally it decreases the yield.

The reason behind this particular phenomenon is the apical dominance. The



Fig. 14.13: Bending

terminal buds synthesize auxins which controls cell elongation and plant growth. The auxin thus produced moves downwards and inhibits the growth of lateral buds on the shoot. Auxin gets accumulated on the lower side of branch (side which is away from the sun) and cause cell elongation on that side to turn to new shoot growth towards the sun.

To break this apical dominance and to bring all the buds at the same level in order to increase the fruit bearing area. The erect growing branches are bent down wards. i.e. horizontal. More auxins get accumulated on the lower side causing cell elongation. The lateral buds are brought at the same level which sprout and give more fruiting area which ultimately increases the yield.

Varieties like Lucknow-49 (Sardar) because of their horizontal growing character do not require bending.

14.6.4 Ringing

Ringing is followed in mango to induce fruitfulness. It is nothing but removal of bark on the branches, in circular fashion of the width of $\frac{1}{4}$ inch to $\frac{1}{2}$ inch. The object behind this operation is to interrupt the downward flow of carbohydrate and to accumulate it at above the portion of operation to induce fruitfulness.

Many times, tree produces only vegetative growth and all the carbohydrates are utilized for vegetative growth without any accumulation.

In alternate bearing trees, during on year all the carbohydrate is utilized for

development of fruit and hence very little quantity is available for differentiation of buds resulting in off year next season. For sprouting of flower buds, accumulation of carbohydrates is essential. To achieve this, ringing is done in mango.

This operation is done in the month of August i.e. 4 months, before the expected date of flowering. It is done on main limbs of at least 6 inch in diameter by removing a circular bark ring of $\frac{1}{4}$ inch to $\frac{1}{2}$ inch thickness. The

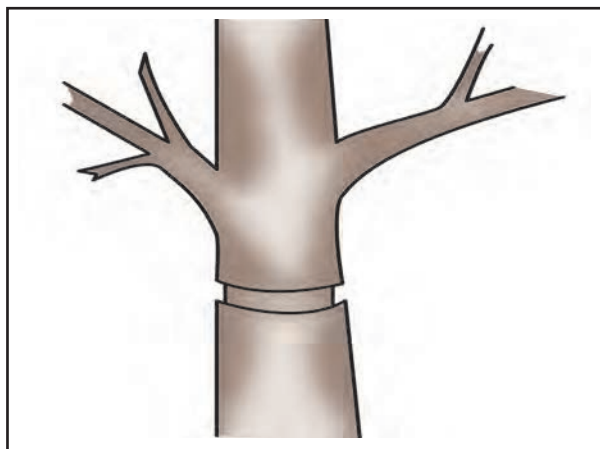


Fig. 14.14: Ringing

cut given to the stem or branch of the tree should not be too deep, and it should not injure the cambium otherwise the upward nutrient supply will be checked. Bordeaux paste should be applied on the ringed part to check the fungal attack. It is not followed as a regular orchard practice. Normally, healing of the wound take place in about a month after the purpose of the operation is over.

14.6.5 Girdling

Girdling is a special horticultural operation followed in grapes. Removing of a circular piece of bark from the cane, main branch or primary or secondary arms for maximizing the yield of good quality is done.

Objectives

1. Better development of berries.
2. To increase the size of berries and the TSS (Total soluble solids) of berries.
3. To interrupt downward flow of carbohydrates.

4. To obtain early fruit maturity and enhance the quality of bunch. Girdling is done one week after the fruit set and on Cane, Main bark, Primary or Secondary arms.



Fig. 14.15: Girdling

Cane girdling is normally followed because in case of trunk girdling, if the operation is not performed systematically, there lays a danger of dying of the vine.

In cane girdling, a ring of bark of the width 2.5 mm is removed carefully from the basal portion of cane. With a sharp knife, clear cut is given. Proper sanitation is followed before and after the operation to avoid disease incidence. The operated portion should unite in 3-4 weeks.

14.6.6 Notching

Notching operation is followed in fig and involves giving a slanting cut little above or below the buds and removing the slice of the bark of particular depth and width depending upon the size of the branch. The main object behind notching is interruption of downward flow of carbohydrate and induce flowering when done below the bud and also induce laterals on vigorous shoots when done above the bud.

It includes partial removal of slip of bark of 2-6 mm breadth and 15-20 mm in length. Bud selected for notching should be large, plumpy, healthy and which is produced on perfect mature wood.

Generally 3-4 buds in the middle portion of shoot are best for operation.

When it is done above the bud, carbohydrates will accumulate above bud and there will be more nitrogen in bud which will give vigorous vegetative shoots on which flowers and fruits will be borne. In Maharashtra notching above the buds is generally followed in August -September.

When it is done below bud, there is more accumulation of carbohydrates than nitrogen, resulting in more fruit buds on the tree. It is done in the month January - February. Bordeaux mixture paste needs to be applied on the wound to avoid attack of pest and diseases.

14.6.7 Hardening

The term hardening is defined as any treatment that makes the tissues firm to withstand unfavourable environment like low temperature, high temperature and hot dry wind.

Hardening is physiological process. Plants accumulate more carbohydrates reserves and produce additional cuticle on the leaves.

In this process seedlings are given some treatments at least 7-10 days before removing from the beds and transplanting.

These treatments include

- (1) Exposure to the full sunlight,
- (2) Removal of all the shedding nets.
- (3) Stopping irrigation slowly.

Techniques of hardening

The hardening is done by the following ways.

- (1) By withholding the watering to the plant by 4-5 days before transplanting. Lowering the temperature also retards the growth and adds to the hardening processes.
- (2) By application of 4000 ppm NaCl with

irrigation water or by spraying of 2000 ppm of cycocel.

Duration and degrees of hardening

It is very necessary that plants should be hardened according to their kind so that there is an assurance of high percentage of survival and slow growth under the condition to be expected at the time of transplanting. Hardening should be gradual to prevent or check the growth. Warm season crops like tomato, brinjal and chillies do not favour severe hardening. Under Indian conditions, allowing the soil to become dry, 5-6 days are enough for desired hardening.

Effect of hardening

The following effects may be observed by the hardening

- (1) Hardening improves the quality and modifies the nature of colloids in the plant cell enabling them to resist the loss of water.
- (2) Hardening increases the presence of dry matter and regards in the plants water and transpiration per unit area of leaf.
- (3) Decreases the rate of growth in the plants
- (4) Hardened plants can withstand better against unfavourable weather conditions like hot day winds or low temperature.
- (5) Hardening of the plants increases the waxy covering on the leaves.
- (6) Development of pinkish colour on leaf petioles and blades.

Exercise

Q 1 A. Fill in the blanks.

1. Horticulture is a branch of agriculture that deals with cultivation of ----- plants.
2. The branch of horticulture that include study of vegetables is known as -----.
3. The central plant in quincunx system is called as ----- tree.
4. Training aims in development of strong ----- of fruit tree.
5. Better light penetration is possible in ----- method of training of fruit crops.

B. Make the pairs.

A	B
(1) Pomology	(a) Hill slopes
(2) Olericulture	(b) Study of flowers
(3) High density planting	(c) Study of vegetables
(4) Rectangular system	(d) Study of fruit crops
(5) Contour system	(e) Declining land to plant ratio
	(f) Wind breaks
	(g) Mechanical cultivation

Q 1 B Find the odd out.

1. Square, Rectangular, Triangular, Hexagonal, Fencing
2. High head, Low Head, Girdling, Open centre, Central Leader
3. Girdling, Bending, Ringing, Bahar treatment, Bearing
4. Road side site, Fertile soil, Cheap labour, High density planting, Availability of market, FYM.
5. Insecticide, Compost, Bone meal, Leaf mould

C. State true or false.

1. Wind breaks protect fruit orchard from hot and dry winds.
2. One of the objectives of pruning is to control flowering and fruiting.
3. Flowering occurs in June – July in case of ambe bahar.
4. In cane girdling a ring of bark of the width 2.5 cm is removed.
5. In high density planting banana plants are planted at 3m × 3 m spacing.

Q 2 Answer in brief.

1. Write short notes on
 - (i) Bahar treatment
 - (ii) High density planting in Mango
 - (iii) Open centre method of training
 - (iv) Ringing
 - (v) Bending
2. Give difference between
 - (i) Ringing and girdling
 - (ii) Training and pruning
 - (iii) Central leader and open centre
 - (iv) High head and low head system of training
3. Give reasons
 - (i) It is necessary to plan carefully while developing new orchard.
 - (ii) Open centre method is better method of training fruit crops.
 - (iii) In case of cane girdling, width of removed bark should be 2.5mm only.
 - (iv) High head system of training is not practiced in tropical region.
 - (v) Bahar treatment is necessary for santra in Maharashtra .
4. Give examples of
 - (i) Methods of crop maximization
 - (ii) Types of bahar.

(iii) Methods of training.

5. Answer in brief.

- What are the advantages of planting wind breaks?
- What are the objectives of training?
- What are the types and benefits of fencing?
- Which points are required to be kept in mind while planning a new fruit orchard?

Q 3 Answer the following questions.

1. Complete the table.

Method	Crop	Width	Benefits
Girdling			
Ringling			

2. Explain with the help of examples.

- Planting of wind breaks
- Live fencing

3. Calculations.

- Calculate number of fruit plants required for planting one hectare area in hexagonal system at 6×6 m distance.
- Calculate number of fruit plants required for planting three hectare area in quincunx system at 2.5×2.5 m distance.

Q 4. Answer in detail.

- Write the importance of horticulture.
- Explain the scope of horticulture.
- Write in detail about selection of site for an orchard.
- Complete the table.

Sr. no.	Method	Main Objective	Followed in Crops	Time
1	Training			
2	Pruning			
3	Bahar treatment			
4	Bending			

5. Read the given following paragraph and answer the questions.

Fencing is essential to prevent destruction of the trees from stray cattle and also to protect the orchard from stress passing. It is necessary to provide some kind of fencing on all sides of the garden and this should be done preferably before planting the fruit trees. Fencing helps to mark the borders of the orchard. Fences may be made using thorny and dead bushes but these are not satisfactory and require frequent repair and replacement. Barbed wire fencing is very good but its initial cost is rather high.

Types of Fencing:-There are two types of fencing used for protection of orchard.

1. Live fencing 2. Non-living fencing

(1) Live fencing - The best protection is however, a construction of live fence. Some of the plants are very useful as live fence.

1. *Prosopis juliflora* (vilayati babul) and *Caesalpinia sepiaria* (Chillari):- These can be established in May June the seed should be sown in a trench 30 cm wide and 22.8 cm deep all around the orchard boundary.

2. *Carissa carandas* (Karonda):- This makes an effective dense hedge. In addition it bears fruits if not pruned too closely.

Other live plant use as fence:-

Lantana camara (ghaneri), cacti, Coenel, dedonia, mendi, casurina (khadsarni, sher), *adulsa*, *shendri* etc.

Questions

- Which are the two types of fencing?
- Why fencing is necessary for fruit orchard?
- Mention some plant species used for live fencing.
- Can you suggest any alternative system of fencing?
- What is the significance of live fencing?

Activity: Practice different special horticultural operations