CHAPTER 3

Principles of Horticulture Crop Production Technology

OBJECTIVES

After studying this chapter, students will be able to:

- Select the appropriate location for raising desirable horticultural crops under a given climatic conditions.
- Select the suitable lay out plans for different horticultural crops.
- Plan various key operations for establishing new orchard/garden.
- Manage the horticultural crops by making efficient uses of available resources.
- Decide on the most appropriate cultivation system for a given situation.

INTRODUCTION

As you might be aware after studying chapter I that, 'Horticulture' deals with a large number of plant species. Traditionally, it includes fruits, vegetables, and ornamental plants. It deals with a combination of the botanical and agricultural aspects of plants. Thus, one may define horticulture as the culture and biology of garden crops, including both the aesthetic and the scientific dimensions. Basic principles of physics, chemistry, and biology are used by horticulturists to understand and manipulate plant life. Therefore, it is essential to understand the fundamental principles of horticultural crop production in order to grow them successfully and fetch economic returns.

PRINCIPLES OF FRUIT PRODUCTION

The commercial production of fruits is known as orcharding. Grape plantations are called vineyards, and the cultivation of grapes is called viticulture. Similarly, citrus orchards are typically called citrus groves and the cultivation of citrus is known as citriculture. Orcharding and other types of fruit growing require high capital investment for years on a fixed site, without immediate return.

SELECTION OF SITE

Selection of suitable site is the first step for establishing an orchard on commercial scale. Selection may be made based on the following criteria;

- The land chosen for orchard should be in proximity to main road and market.
- It should have proper irrigation facilities and have a good soil and climate suitable for growth and production of fruit trees.
- Experience of the fruit growers and research stations in the locality should be taken into account for the acclimatization of the fruits under consideration.
- Adequate water supply should be available round the year.

Any mistake in selection of site cannot be altered after planting while modifications in other factors are possible.

Preliminary Operations for establishing an orchard

After selecting the suitable location and site, some preliminary operations have to be done. Trees are felled without leaving stumps or roots. The shrubs and other weedy growth are also cleared. Deep ploughing is essential to remove big roots. The land should be thoroughly ploughed, leveled and manured. Leveling is important for economy of irrigation and preventing soil wash. In the hills, the land should be divided into terraces depending upon the topography of the land and the leveling is done within the terraces. Terracing protects the land from erosion. If the soil is poor, it would be advisable to grow a green manure crop and plough it in situ so as to improve its physical and chemical conditions before planting operations are taken up.

Planning of an orchard

A careful plan of the orchard is necessary for the most efficient and economic management. The following points should be considered in preparing the plan.

1. Optimum spacing to accommodate maximum number of trees per unit area.
2. Stores and office building in the orchard should be constructed at the centre for proper supervision. .
3. Wells should be located at convenient places in different parts at the rate of one well for 2 to 4 hectares.
4. Each kind of fruit should be planted in a separate block.
5. Fruits ripening at the same time should be grouped together.
6. Pollinizers should be provided in deciduous fruits.
7. Irrigation channels should be laid along the gradients for most economical conduct of water.

   For every 30m length of channel, 7.5 cm slope should be given.

8. Roads should occupy minimum space for the economy of transport. The clearance between wind break and first row of trees is advantageous for the road.

9. Short growing trees should be allotted at the front and tall at the back for easy watching and to improve the appearance.

10. Evergreen trees should be in the front and deciduous ones behind.

11. Fruits attracting birds and animals should be close to the watchman's shed.

12. A good fence is essential. Live fencing is economic and cheap to other kind of fences. The plants suitable for live fencing should be drought resistant, easy to propagate from seed, quick growing, have dense foliage, should stand severe pruning and should be thorny. *Agave, Prosopis juliflora, Pithecolobium dulce* and *Thevetia* if closely planted in 3 rows would serve as a good live fencing.

13. Wind breaks, rows of tall trees planted close together around the orchard, are essential to resist velocity of wind which causes severe ill-effects particularly moisture evaporation from the soil. Since the wind breaks are very effective in reducing the wind velocity and minimizing the damage to the fruit trees and to other crops, their presence in regions where strong winds prevail is of paramount importance. A wind break ordinarily has its maximum effectiveness for a distance about four times as great as its height but has some effect over twice about that distance.

The most effective windbreak is a double row of tall trees alternately placed. There should be at least as much as space between the windbreak and the first row of the fruit trees as between fruit trees. It is preferable to dig a trench of 90 cm deep at a distance of 3m from the windbreak trees and prune and cut all the roots exposed and again fill up the trenches. This may be repeated for every 3 or 4 years in order to avoid the competition between the wind breaks and fruit trees for moisture and nutrition. Trees suitable for windbreak should be erect, tall and quick growing, hardy and drought resistant and mechanically strong and dense to offer maximum resistance to wind. The trees which are suitable for growing as wind breaks are *Casuarina equisetifolia, Pterospermum acerifolium, Polyalthia longifolia, Eucalyptus globulus, Grevillea robusta, Azadirachta indica* etc.

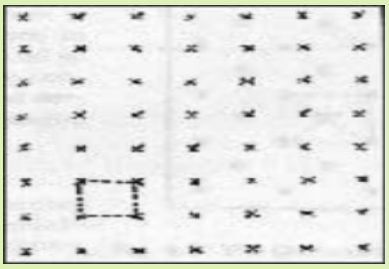
LAYOUT SYSTEMS OF PLANTING

Lay-out means locating the position of trees, roads and buildings in the orchard being established, and systems of lay-out refer to the orderly ways of planting the trees. It is desirable to have the trees planted in systematic way because

- Orchard operations like interculture and irrigation are carried out easily.
- It enables equal distribution of area under each tree.

- It results in least wastage of land.
- It makes supervision more easy and effective.
- There is room for systematic extension of the orchard.

There are mainly five systems of planting of fruit trees. In all these systems, trees are planted in rows.

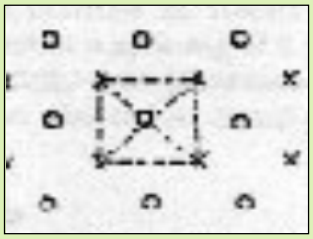


A. Square system

In square system the trees are planted in four corners of a square keeping the same distance between row to row and plant to plant in the same row. This is the most commonly followed system and is very easy to layout. This system permits inter cropping and cultivation in two directions.

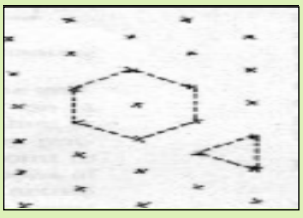
B. Rectangular system

In rectangular system the trees are planted in the same way as in a square system except that the distance between rows to row will be more than the distance between plant to plant in the same row. The wider alley spaces available between rows of trees permit easy intercultural operations and even the use of mechanical operations.



C. Quincunx or Diagonal system

Basically, quincunx or diagonal system is the same as the square system except for the addition of a tree in the center of each square. This will accommodate double the number of plants, but does not provide equal spacing. The central trees are known as filler crop and the others as main crop. The central (filler) tree chosen may be a short lived one. Papaya, Guava, Lime, plum and peaches are a few examples of filler crops in orchards with trees like mango, jackfruit and tamarind. This system can be followed when the distance between the permanent trees is more than 10m. As there will be competition between permanent and filler trees, the filler trees should be removed after a few years when main trees come to bearing.



D. Hexagonal/ septuple system

In the hexagonal system, the trees are planted at the corners of an equilateral triangle. Six such triangles are joined together to form a hexagon. Six trees are positioned at the corners of this hexagon with a seventh in the center all arranged in the three rows.This system provides

equal spacing but it is difficult to layout. This system accommodates 15% more trees than the square system. The limitations of this system are that it is difficult to layout and the cultivation is not so easily done as in the square system.

E. Contour system

In a hilly area, a lot of depressions, ridges, furrows and place surface are found. But when plating is done a line is made by connecting all the points of same elevation across the slope from a base line. Thus spacing is maintained on this row.

The main purpose of this system is to minimize land erosion and to conserve soil moisture so as to make the slope fit for growing fruits and plantation crops. Terrace system on the other hand refers to planting in flat strip of land formed across a sloping side of a hill, lying level along the contours. Terraced fields rise in steps one above the other and help to bring more area into productive use and also to prevent soil erosion. The width of the contour terrace varies according to the nature of the slope. If the slope becomes stiff, the width of terrace is narrower and vice-versa. The planting distance under the contour system may not be uniform.

In the recent past, a new trend has been observed among the growers i.e. adoption of high density planting system. This has gradually becoming imperative due to shortage of land and labour.

High density planting system

High density planting (HDP) can be defined as "accommodation of the maximum possible number of the plants per unit area to get the maximum possible profit per unit of tree volume without impairing the soil fertility status". This technique was first established in apple in Europe during sixties and now majority of the apple orchards in Europe, America, Australia and New Zealand are grown under this system.

Examples of successful HDP in fruit crops: There are quite a good number of success stories of HDP in fruit crops under Indian conditions. Some of them are being listed below with their technical details;

Table 1. Performance of fruit crops under HDP.

S. No.	Crop	Variety	Density	Spacing (m) (Plants/ha)	Yield (t/ha)
1.	Banana	Basarai	4,444	1.5x1.5	78.0
2.	Papaya	PusaNanha	6,400	1.25x1.25	103.6
3.	Pineapple	Kew	63,758	0.22x0.6x0.75	118.8
4.	Guava	Lalit	5,000	1x2	55
5.	Mango	Amrapali	1,600	2.5x2.5	22

CHOICE OF FRUIT TREES

The next step of orchard establishment is choice of fruit crops. The choice of fruit crops is governed by various soil and climatic conditions as indicated in Table 2;

Table 2. Choice of fruit crop as affected by soil and climatic conditions.

Climatic/soils conditions	
Climatic conditions	
Temperate region	Apple, pear, peach, walnut, apricot, almond etc.
Tropical region	Papaya, banana, sapota, coconut, cashewnut, mangosteen, citrus
Subtropical region	Mango, litchi, pomegranate, loquat, grape, pomegranate
Temperate fruits in subtropical region	Low chilling peaches, apples, plums and pears
Arid region	Ber, bael, mulberry, aonla, date palm, phalsa etc.
Semi-arid region	Jamun, woodapple, fig, custard apple, khirni
Cold desert	Apricot, Pistachionut, apple, chilgoza, prunes
Cold sandy desert	Chilgoza nut
Arid temperate zone	Oleaster
Soil conditions	
Coastal sands	Coconut
Sandy soils	Ber, date palm, fig, mulberry, phalsa
Loamy soils	Most of the major fruit crops
Clayee soils	Jamun
Alkaline soils	Guava, date palm, coconut, olive, phalsa
Acidic soils	Raspberry, blueberry, fig, gooseberry
Salt affected soils	Date palm, ber, aonla, bael

All major fruits are clonally propagated by means of cutting, grafting, budding and micropropagation. In modern orcharding, fruit crops are grown as a composite plant. The upper part, which forms aerial part is called as scion, while the lower part, which makes the root system is termed as rootstock. In some cases a third part i.e. interstock, which is used for overcoming incompatibility between the scion and stock is also employed. In most cases, the commercial varieties are used as scion, and the rootstock is of a different species or variety. Rootstocks are known to influence vigour, yield, early bearing, fruit size, and impart tolerance to various soil, climatic and pests & diseases. Some of the important rootstocks of fruit crops are being mentioned below;

Table 3. Rootstocks of fruit crops.

Fruit crop	Rootstocks
Apple	M9, M27, MM111, MM106
Ber	Jharber (*Ziziphusnummularia*), Boradi (*Z. rotundifolia*)
Citrus	Rangpur lime, KarnaKhatta, Rough lemon, Trifoliate orange, Flying Dragon
Grape	Salt Creek, Dogridge, Ripario, Temple
Guava	*Psidium friedrichsthalianum, P. pumilum*
Mango	Kurukkan, Olour, Vellaikolmban
Sapota	Khirni
Walnut	Paradox (*Juglans hindsi x J. regia*)
Fig	*Ficus glomerata*

Spacing

The distance between trees and rows varies with climatic conditions, soil type, rootstock, cultural practices, training & pruning, system of planting, fruit crop and varieties to be planted. The most commonly followed spacing for commercial fruit crops are given below;

Spacing (m)	Tree number/hactare	Fruit crop
2x2	2500	Dwarf papaya, dwarf banana
3x3	1111	Tall papaya, Tall banana, grape
4x4	625	Hazel nut
5x5	400	Peach, pomegranate
6x6	277	Citrus, apricot, almond

7x7	204	Plum, guava
8x8	156	Aonla, ber, bael, litchi
9x9	121	Sapota
10x10	100	Mango, walnut, cherry
12x12	68	Tamarind, pecan nut, jamun

Farm operations like pruning and training of trees and thinning of fruits are unique to pomology and are regular features of an orchard.

Training: It is a physical technique that control the shape, size, and direction of plant growth

Pruning: It is a judicious removal of plant part to improve shape, influence growth, improve flowering, fruitfulness and fruit quality or to repair injuries.

Training systems

Training is practiced to give the shape or build strong framework of the tree in order to support maximum crop of good quality. Selection of training systems depends upon the agro-climatic situation of the region. Generally, three training systems viz., Open Centre or Vase, Central Leader and Modified Leader System are followed for canopy management of fruit plants in different regions.

Orchard cultivation

Orchard cultivation refers to the careful management of the orchard soil in such a way that the soil is maintained in a good condition suitable to the needs of the tree with least expenses.

METHODS OF SOIL MANAGEMENT PRACTICES

a. Clean culture

This type of cultivation is extensively followed in India. This involves regular ploughing and removal of weeds.

b. Clean culture with cover crops

This type of soil management involves raising of a cover crop or green manure after removing the weeds. In India, green manure crops like Sunhemp, Cowpea, Daincha, Lupins etc. are more commonly used. Legume cover cropping in grape, mango, guava and other fruit crops is becoming a common practice in the management of orchards. Cowpea and French beans grow well under guava and sapota tree.

c. Mulching

This is one of the important soil management practices. Crop residues like straw, cotton stalks, leaves, saw dust, pine needles, coir dust arid other materials like polythene films or certain special kinds of paper are spread in the tree basins and in inter spaces between trees. Main objective of mulching is to conserve soil moisture and to control the weed growth.

d. Sod

In this method, permanent cover of grass is raised in the orchard and no tillage is given. This type of orchard cultivation is followed in USA and Europe.

e. Sod mulch

This is similar to sod with the only difference is that the vegetation is cut frequently and the cut material is allowed to remain on the ground.

Intercropping

Most of fruit crops are a slow-growing tree and takes at least three-four years to come to flowering and fruiting. Intercrop like legumes in pre-bearing stage of trees not only provide more income but also improve health of the trees. Vegetables or leguminous crops like pulses, beans, berseem, etc. can be successfully grown during the initial stages. The recommended intercrops for some important horticultural crops are given as under.

Crop	Age	Intercrop
Mango	Upto 7 years	Leguminous vegetables, Papaya (filler)
Grapes	Upto 8 months	Snake gourd or bitter gourd in pandal
Apple, pears	Upto 5 years	Potato, Cabbage
Banana	Upto 4 months	Sunhemp, onion
Tapioca	Upto 3 months	Onion, beans, lab-lab, black gram
Turmeric	Upto 3 months	Small onion, coriander
Arecanut	Upto 10 years	Pineapple
Coconut	Upto 3 years	Banana, tapioca, vegetables

Multi-tier system of cropping

The system comprise of a combination of perennial and annual plant species as different components in the same piece of land arranged in a geometry that facilitates maximum utilization

of space in four dimensions (length, width, height and depth) leading to maximum economic productivity of the system. Certain horticultural plants like coconut and arecanut are grown for about 50 years in a particular land. It takes nearly 4 to 7 years for the above trees to reach the bearing stage. Adequate alley spaces (nearly 75%) are available in between these trees. Hence, these vacant spaces can be profitably used for raising other crops, thereby increasing the employment opportunities and profit. An ideal combination of crops for multitier cropping in coconut and arecanut plantations is as follows.

Tier	Crop
First (Top)	Coconut or arecanut
Second	Pepper trained over the trunk of coconut or arecanut trees
Third	Cocoa or cloves planted at the centre of four arecanut or coconut
Fourth (ground)	Pineapple, ginger and dwarf coffee

Crop regulation

Fruit crops like guava and pomegranate has three main flowering and fruiting seasons or bahars, ambebahar (spring season flowering), mrigbahar (June-July flowering) and hasthbahar (September-October flowering). Theses crops flowers continuously when watered regularly. For commercial production, only one crop in a year is desirable. Therefore, by crop regulation, the tree is forced to rest and thereby produces profuse blossoms and fruits during the required bahar. Selection of the bahar depends mainly on the availability of irrigation water, risk of damage by diseases and pests and market factors.

For bahar treatment, operations like withholding irrigations, root exposure, root pruning and spray of chemicals (thiourea, NAA or potassium iodide) are practiced to induce leaf drop and cessation of growth during the period of the unwanted bahar. The recommended doses of fertilizers are applied immediately after pruning and irrigation is resumed. This leads to profuse flowering and fruiting. The fruits are ready for harvest 4-5 months after flowering.

PRINCIPLES OF VEGETABLE CULTIVATION

As compared to orcharding, the vegetable industry is characterized by its flexibility. Because most vegetables are grown as annuals, shifts in cultivars and crops can be readily made. There are three main categories of vegetable production: home gardening, market gardening, and truck gardening. In addition, there are several small, specialized production types including vegetable forcing, production for processing and seed production.

From ease in recommending the general cultivation practices, vegetable crops have also been classified based on method of cultivation. In this method all the crops, which have similar

cultural requirements are grouped together. For instance, cucurbits (musk melon, water melon, bottle gourd, ridge gourd, cucumber etc.), cole crops (cauliflower, cabbage, broccoli), root crops (beet root, carrot, radish), bulb crops (onion and garlic) not only have similar cultural requirements for the group but the crops in each group usually belong to same family.

There are some principles required in the production of vegetable crops which are very important and well known to the grower. These principles are:

1. Production of vegetables does not involve a long time investment as does in the orchard of guava, mango, or apple.
2. Vegetable growers/farmers are not bound to produce the same crop each year like his counterparts, who grow fruit crops.
3. Vegetable growing lacks the stability which is methodically developed over a period of years like an orchard thus, getting into vegetable production is a fast process and getting out may even be faster.
4. Vegetables can be grown by people with limited experience. Only skillful farmers sustain their vegetable production.
5. The land for production of vegetable crops is flexible and adjustable. It is much easier for vegetable growers/farmers to change production from one crop to another than for fruit crop grower.
6. Cooperative efforts and organizations are somewhat more difficult with vegetable crop producers than fruit growers. Vegetable/grower/farmers have no long period for making plans. Vegetable production is seasonal.
7. Vegetable production requires more intensive production management per unit area and time.

Vegetable nursery raising

Most vegetable species are grown from seeds, but some important ones (e.g. pointed gourd, colocasia, basella, ivy gourd etc.) are propagated by vegetative methods. Among those grown from seeds, a significant number mainly those with small seeds (e.g. tomato, brinjal, cauliflower, cabbage etc.) are usually first sown in nursery beds, boxes or containers and are transplanted at a later stage. Nursery raising have several advantages like economy of seeds, uniformity of growth and selection of vigorous & healthy seedlings for transplanting.

Field establishment

Land Preparation: In preparing land for vegetable production, factors such as ecological location, mode of cropping, season, crop disposition, and the type of vegetables to be grown

should be taken into consideration. The land should be first cleared off of existing vegetation followed by leveling and suitable tillage operations

Planting: Vegetables can be propagated either by direct sowing or by transplanting methods.

Direct sowing: Vegetables are sowed either by broadcasting or by seed drilling methods. In broadcasting, seeds are spread over the prepared land by throwing small quantities of the seeds into the air close to the surface of the prepared land. This is followed in *Celosia* and *Amaranthus*. Seed drilling method is followed for planting small seeded vegetables in rows. Shallow furrows are made at the spacing recommended for the crop and the seed drilled along the furrows. This method can also be used for some leafy vegetables such as *Celosia* and *Amaranthus*.

Transplanting method: Vegetable seedlings are first raised in the nursery for a required period of time before they are transplanted on the field. Seedlings are transplanted in the morning or in the evening to avoid transplanting shock.

SOME ROUTINE OPERATIONS

Thinning: Thinning of vegetable is done to reduce the number of seedlings per stand.

Supplying or gap filling: This is the practice of providing missing stands of vegetables planted by direct sowing as a result of poor emergence or when seedlings are damaged by pests.

Staking: This is usually required for vegetables with climbing growth habit such as fluted pumpkin, or those with weak stems such as tomato. Stake can be made from bamboo or other available wood. The support allows the plant to carry more load without touching the soil thus enhancing the quality of the fruit.

Mulching: A mulch is a layer of plant residue or other materials like plastic or paper, which is applied to the surface of the soil in order to reduce evaporation, run-off or to prevent weed growth. The purpose of mulching is to conserve soil moisture.

Watering: Young vegetable seedlings in the nursery or in the field should be watered in the early morning or in the evening. Watering should be done before transplanting particularly in the evening. Likewise, over-watering can be very harmful and can encourage the development of pathogenic diseases and also cause mechanical damage to the seedlings.

Fertilizer application: Vegetables must be provided with ample supplies of nutrients such as nitrogen. Application of N fertilizer has been shown to increase yield. In some tropical leafy vegetables, fertilizers such as FYM and other sources of P and K can be applied as pre-plant basal dressing or after the plants have become established as post planting application.

Weeding: Weeds can be managed using cultural, physical, chemical and biological methods. Weed seeds and rhizomes can be killed using physical method during land preparation by burning. Mulching of soil can also smother weeds. Hoeing, pulling and roguing are carried out during the early stages of growth. Chemical weed control is applied in commercially grown vegetable crops.

PRINCIPLES OF FLOWER CULTIVATION

In a garden there are certain operations that are to be followed judiciously for successful cultivation of ornamental plants. Most of these operations, such as transplanting, pruning, pinching, etc., are of vital importance for the growth of the plants. Some other operations, such as topiary or shearing of hedges, are designed to enhance the ornamental or aesthetic value of the plant material.

Some routine operations

Soil Sterilization: This is an essential operation to eliminate soil-borne diseases, caused mainly by fungi. Soil can be sterilized with 2 per cent formalin (or formaldehyde). The formalin solution is mixed thoroughly with the soil and this is covered with tarpaulin or gunny bag for 48 hours. Some fungicides such as benlate, captan, bavistin, brassicol, and blitox (0.1 to 0.2 per cent solution) are also used for soil sterilization.

Seed Sowing: Sowing of seed is an important operation for annuals, biennials, and some herbaceous perennials, as seeds of most of them are very minute and need special care during sowing. The seeds of trees are quite bold and do not require as much care as is required for annuals.

Pricking: Pricking out, also known as thinning out, means removing the seedlings from their original container and replanting into individual pots or transferring into beds to give them more growing space.

Planting and Transplanting: Planting and transplanting are two important operations. The time of planting depends on the climate of the area. Deciduous plants are transplanted during the dormant season when they are in leafless condition. This is done only on the hills and at places having cold winter. The other season of planting is spring when new growth takes place, provided the plants can be given sufficient care and irrigation during the ensuing summer. Under Indian conditions, the best period is to transplant during the rainy season, provided there is no water-logging. The pits should be dug before the rains start.

Planting of shrubs and trees: During digging the pits for planting, the surface soil should be kept separately and not to be mixed with the rest of the soil. After digging the pit, the soil is

returned to the pit mixed with the requisite quantity of manure, the surface soil going on the top. While planting, a small hole is made at the centre of the pit and the plant is placed with the ball of earth. The plant should not be placed deeper than when it was in the nursery. After transplanting, the earth around the root should be finned thoroughly. A basin should be made on the ground around the plant for watering.

Transplanting: There are generally four types of transplanting in a garden: (1) Transplanting a potted plant to ground, (2) Transferring a potted plant to another pot, (3) Potting a ground plant, and (4) Transplanting of large trees and shrubs from the ground to another suitable location poses problems. For lifting very large trees, the help of tree-lifters or cranes and trucks will be needed.

Shading: Shading and protection of plants is an important operation in a garden, especially in places having hot summers and severe winters. The newly planted seedlings or plants need shade from the scorching summer sun. In places, where frost is likely to kill the plants these should be given proper protection. The seedlings in the nursery also need shading.

Stopping or Pinching: The operation of pinching or stopping involves the removal of the growing-point of a shoot along with a few leaves. The two main purposes of this operation are to encourage branching to produce a bushy growth, and/or the production of flower-buds on the branch which is pinched. Pinching is done mostly in annuals and herbaceous perennials and is hardly required for any flowering trees. The plants which need pinching include dahlia, chrysanthemum, carnation, brachycome and marigold.

Deshooting: Deshooting involves the removal of shoots that are not wanted. Some flowering annuals and herbaceous perennials produce numerous side shoots and if all of them are allowed to flower, the size and quality of the flowers will be greatly reduced. Deshooting of carnations grown for cut flower trade and chrysanthemum for exhibition purposes are common practice.

Defoliation: The removal of foliage is known as defoliation. This is done mainly with a view to induce flowering in certain plants. Sometimes, this can also be done to reduce transpiration loss during periods of moisture stress and also during transportation of certain plants such as roses. Defoliation can be achieved by the removal of leaves by hand or by the use of chemicals and by withholding water. In jasmine, it is a common practice to defoliate the plants after pruning just prior to the flowering season.

Staking: Plants in the garden, either in pots or on ground, need support at least for a part of, or throughout, its life. Stakes may be of various kinds. The most common stakes used in India are made of either whole bamboo or split bamboo of various sizes depending upon the type of plants to be staked. Some other types of stake which are commonly available under Indian

conditions and can be used as stakes for herbaceous plants are the dried stems of jute, cotton and pigeon pea.

Pruning: The planned removal of branches, twigs, limbs, shoots, or roots is termed as pruning. Even the removal of a dried flower can be termed as pruning. Each pruning is done with a view to increase the usefulness of a plant.

Wintering: This may be considered as an alternative to root pruning. In hotter parts of India, it may not be wise to resort to root pruning. In such places ornamental plants are "wintered". During resting period, the water supply to the plant to be wintered is stopped for a few days and the roots are exposed to the sun by removing the surface soil around the trunk. After wintering, the roots are covered with the same soil enriched with farm yard manure and copiously watered.

Clipping or Cutting of Hedges and Edges: To keep the hedges in symmetry, good health, and beauty, constant vigilance and regular shearing or pruning are needed. A sharp pair of pruning shears is used for clipping the herbaceous twigs. But to cut woody branches, secateurs or pruning saws will be required.

Topiary: The art of clipping and shearing shrubs and small trees and sometimes even herbaceous perennials into ornamental or abstract shapes is known as topiary. The term is derived from the ars *topiaria* meaning ornamental gardening. Shapes such as globe and dome can be given without the help of any pre-fabricated moulded wire model. But difficult shapes such as bird, animal, etc., are to be obtained by preparing a rough outline with wires and then training the shrub along the frame and clipping carefully over years to get the desired shape.

ACTIVITY/EXERCISE

1. Visit orchards situated in your area and try to find out which system of planting is being followed there. Compare the practices being followed in those orchards with modern practices, which you have learnt in this chapter.
2. Plan a suitable scheme for an orchard, along with important fruits and their varieties, suitable intercrops, on 10 hectare of land in your region.
3. You can visit vegetable gardens of your locality and try to find out, which system of vegetable growing is practiced, predominantly.
4. Choose some ornamental flowering plants like marigold or carnation and separate them in two sets. Apply pinching and deshooting practice to two different sets of plants, separately. Compare the size of flowers formed as a result of such practice.

CHECK YOUR PROGRESS

1) Name the important systems for layout of fruit orchard. Explain each briefly.

2) What is high density planting? Cite some successful examples of HDP in fruit crops.

3) Write the most commonly followed spacing for different commercial fruit crops.

4) Enlist different methods of soil management practices in fruit crops.

5) Enlist different types of vegetable production system.

6) Name vegetable crops, which are usually transplanted in field for cultivation.

7) Differentiate between pinching and deshooting.

8) What do you mean by topiary?

9) How soil is sterilized to get rid off of fungi and other pests?

10) Name an ornamental crop, which is defoliated for improved flowering.

FILL IN THE BLANKS

1. Quincunx system of laying out orchard is also termed as……system.

2. Recommended spacing between two tamarind plants is…….m.

3. …….. is judicious removal of plant part to improve shape, influence growth, improve flowering, fruitfulness and fruit quality or to repair injuries.

4. Bahar is practiced in fruit crops like…….. and ……

5. Vegetatively propagated vegetable crops are……., …….. and ……

6. The purpose of mulching is to conserve ……

7. Pricking out is also known as …….. out.

8. The removal of ……. is known as defoliation.