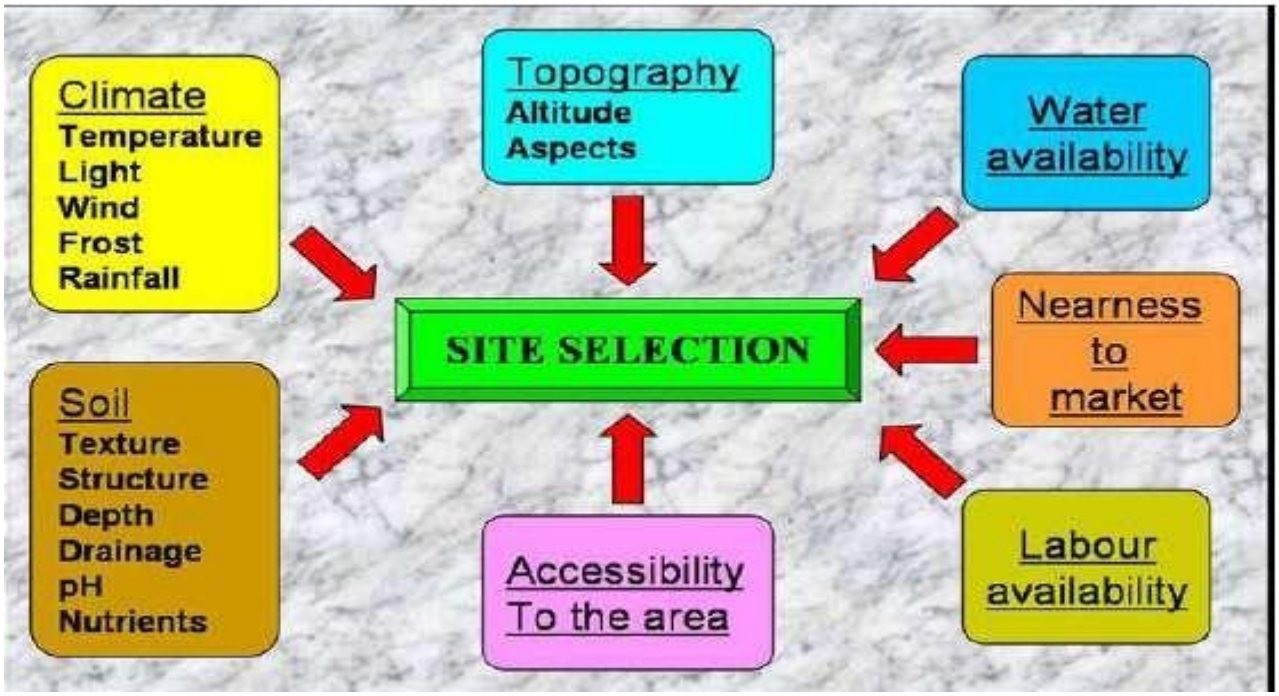
Lecture-5
ESTABLISHMENT OF ORCHARD

The establishment of an orchard is a long-term investment and deserves very careful planning. The selection of proper location and site, planting system and planting distance, choosing the varieties and the nursery plants have to be considered carefully to ensure maximum production.

Selection of site: The following factors are to be considered before selecting a site for an orchard.



1. Climate: The climate of the locality should be suited to the fruits, or the fruit chosen should be suited to the climate. Enquires should be made on the following points to assess how climate affects the fruits intended to be grown.

1) Experience of the fruit growers and research stations in the locality regarding the acclimatization of the fruits under consideration.

2) The seasons of heavy rainfall, hail storms and hot winds.
3) The seasons and intervals of cyclones, heat waves, gales and other catastrophic features

2. **Soil status:**
3. **Irrigation facilities:**
4. **Nearness to the market:**
5. **Transport facilities:**
6. **Power (electricity) supply:**
7. **Proximity to established orchards:**
8. **Availability of labour:**
9. **Presence of nurseries close:**
10. **Cost of the land:**

ORCHARD PLAN

It is of great advantage to prepare a plan of the orchard in advance, be it a home or market garden or a commercial orchard. A detailed survey of the site is carried out including the levels and a good map to scale is drawn. A full knowledge of the fruits to be grown and their cultivation is also prerequisite for efficient planning.

The guiding principles in the preparation of plan are:

1) The orchard should be managed most profitably
2) It should present as attractive look as possible.

The following **general principles** may be borne in mind while drafting a plan and as many of them as possible should be fulfilled. It should be recognized that not all of them can be adopted in every case.

- If the entire area is not of the same type of soil, each fruit should be allocated to the soil type it prefers.
- The irrigation sources should be marked and channels indicated

along gradients with a view to achieve most economical conduct of water.

- Irrigated fruits should be close to the source of irrigation to avoid long irrigation channels and consequent loss of water during conduct.
- Tall wind breaks should be planted especially on the sides from which high winds are expected. There should be adequate clearance between the wind breaks andthe crop.
- Roads should be planned to occupy the minimum space consistent with economy of transport of orchard requisites and produce. The space between the wind break and the first row of fruit trees may often be utilized for roads and canals etc. with advantages.
- Drains should follow the gradient of the land, should be as straight as possible and concealed from the visitors, if possible.
- When varieties with pollen preferences are planted they should have the pollinizer in an adjacent block or in alternate rows so as to ensure good crop set.
- Fruits which ripen at the same time should preferably be grouped together to facilitate easy watching and harvesting.
- Assign rear areas for tall trees and the front for shorter ones will besides facilitating watching, also improves the appearance of the orchard. The orchard should in general present an aesthetic appearance so as to provide marked attraction.
- The spacing adopted should be the optimum.

The spacing allowed is usually such that the fringes of the trees will just touch oneanother cutting out light but should not interlock.

With in reasonable limits, closer spacing gives more yields in the earlier

age. But in laterlife, the trees tend to grow taller than broad resulting in difficulty in pruning, spraying and harvesting. They also suffer from root competition inadequate nutrition, fewer fruits which tend to be smaller with comparatively poorer in colour development. So, adoption of closer spacing to accommodate more plants per acre proves to be a false economy in the long run. The spacing given to fruit plants depends on the following factors.

a) The habit of growth of the plant: The spacing being equal to the spread of theplants.
b) Rainfall: In the case of rain fed crops closer spacing is given in lighter rainfallareas than in heavy rainfall areas.
c) Nature of soil: Trees on stiffer soils may be given less spacing as both their topand root spread are limited in such soils.
d) The root stock: Root stock influences the spread of the trees and to that extentdetermines the spacing to be adopted.
e) Pruning and training
f) Irrigation system.
g) The method of layout should be fixed in advance so that the no. of plantsrequired is worked out and arranged for.

STEPS IN ESTABLISHMENT OF AN ORCHARD

After the selection of the site and drafting the plan, next comes the establishment ofan orchard with fruit plants. For this, the selected site should be thoroughly surveyed for studying its size, topography, flow of irrigation water, drainage and fertility gradients. The positioning of main and subsidiary roads, wells, wind breaks etc. should be planned clearly.

Steps:

1. **Clearing of the land:**
2. **Leveling:**
3. **Fencing:**

Characteristics of a good fence plant:

- ✓ Drought resistant
- ✓ Easy to raise from seedQuick growing
- ✓ Should have dense foliage
- ✓ Should stand severe pruning
- ✓ Should not be hard to secature
- ✓ Should be preferably thorny

Live fences are sown at the commencement of the rainy season to minimize irrigation. They are dibbled in 3 rows; 20-30 cm apart in a trench dug 60cm deep and manured soil.

Examples of **non-thorny fence plants**: Tamarind, Thevitia, Lawsonia, Casuarina, Gliricidia etc. Examples of **thorny fence plants**: Agave, cactus, Prosophis, Commiphora *barli*, *Inga dulcis* etc.

4. **Wind break plants:** The beneficial effect of wind break is felt up to a distance equal to 3 times its height.

The characteristics of a tree suitable as wind break are:

- ✓ It should be fast growing

- ✓ It should be easily establish.
- ✓ It should be able to acclimatize to the environment
- ✓ Should have dense canopy
- ✓ It should be frost resistant
- ✓ It should be drought resistant
- ✓ It can be propagated by various methods
- ✓ Planting material should be easily available and cheap
- ✓ It should have multipurpose uses like fuel wood, fodder etc.
- ✓ It should with stand periodical pruning.

Wind Breaks

5. Roads and drains:

6. Tillage:

7. Sowing green manure crops: Marking plant positions:

8. Digging and filling of pits:

9. Filling of pits:

10. Selection of plants from the nursery:

11. Lifting and packing:

12. Season of planting: The distribution of rainfall in the tropics and subtropics and the break of spring growth in the temperate zone determine the season of planting. In tropical climate, most trees are

planted between July and December and few in January also. In general planting is done during the monsoon in moderate rainfall areas and at the close of the monsoon in heavy rainfall areas.

Planting should be done on cloudy days and preferably in the afternoons rather than inthe morning.

13. Planting: The planting board should be used at the time of setting the plants, so that they are in a perfect line. The plants should be set in the soil to the same level asit was in the nursery. The bud / graft joint should not be covered with soil. Plants should be irrigated once copiously to get the soil particles to closely adhere to the roots and also to drive away the air around the roots completely. The plants should be staked with a straight bamboo piece or other twig. Graft bandage should be removed if not already done. Any buds on the rootstocks should be rubbed off.

14. Heeling inn: If the plants after transport are not directly planted in the field, they may be kept in shade in a slanting position along the side of a trench moistening the ball of earth .They may be left in this position till active growth commences by which time they should be planted in the field. This process is known as healing inn.

SYSTEMS OF ORCHARD PLATING

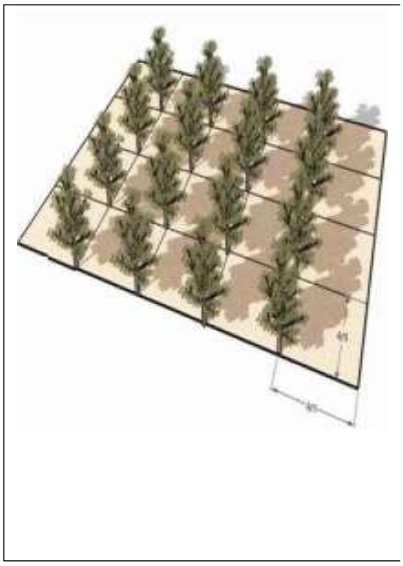
The arrangement of plants in the orchard is known as lay-out. The following points need to be considered before choosing a system of planting.

- It should accommodate maximum number of plants per unit area.
- It should allow sufficient space for the development of each tree.
- It enables equal distribution of area under each tree.

- The intercultural operations such as ploughing,spraying etc are easily carriedout.
- It makes supervision more easy and effective.

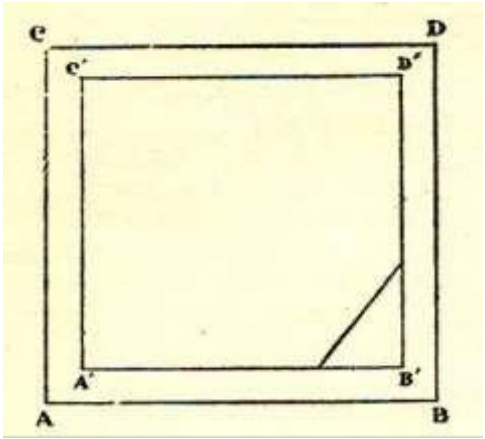
Descriptions of the different systems:

(1) Square system:



- In this system a tree is planted at each corner of a square what ever may the Planting distance.
- The distance between row to row and plant to plant is same.

Procedure for lay out:



Step no. –1: –ABCD‖ is the area where the trees are to be planted. The first step will be establishing a base line. Select the baseline parallel to the road or fence or the boundary of the orchard. This

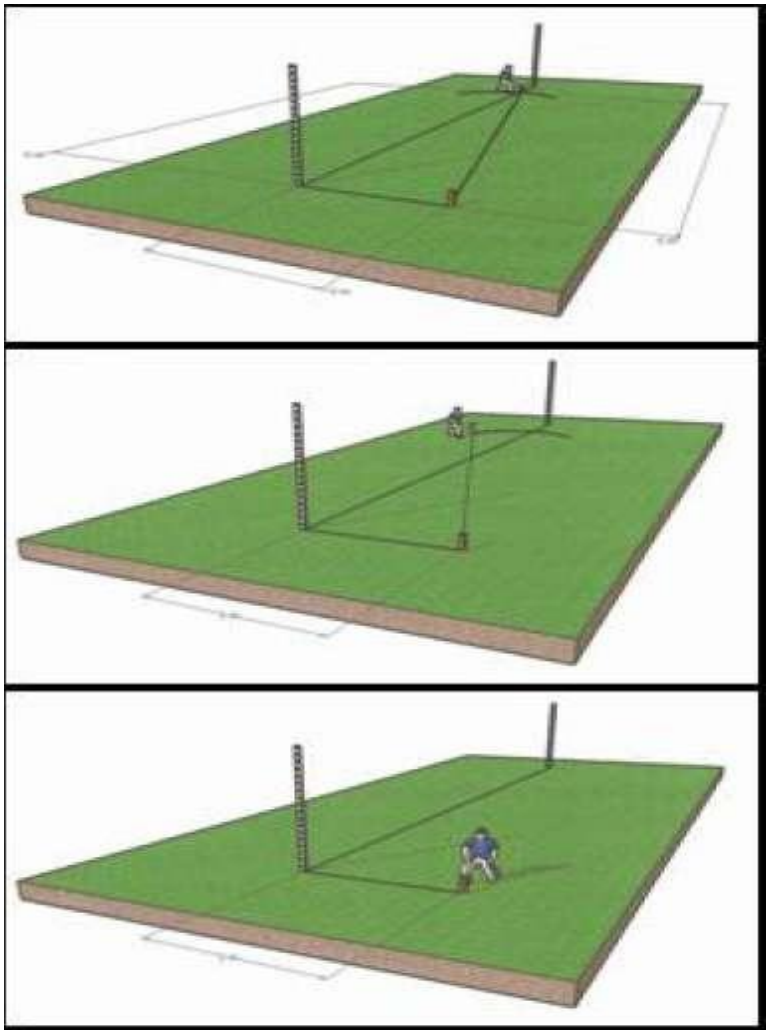
should be drawn at half a distance of the spacing that is to be followed. For example, if the spacing is 10m, the base line should be drawn at a distance of 5m from the periphery of the plot.

Step no.-2: Towards end of the base lines leave again a gap of half the spacing from the boundary or road or fence etc. and put the peg on one end of the base line. From this peg measure one planting distance and put the second peg on the base line. Thus, continue placing pegs at each of the planting distance till the total length of the base line is covered. The distance from the last peg to the boundary should also be at half the spacing.

Step no.-3: From the first peg and the last peg on the base line, draw perpendicular lines. The perpendicular lines may be drawn by adopting any of the following methods. **Cross staff method:** Cross staff comprises of a wooden block with two perpendicular slits made on its surface and fixed to an iron rod.

- Fix the iron rod in the position of the first peg. See thorough the slit parallel to the base line and see that it lies in line with the base line.
- Now see through the other slit perpendicular to the first one and fix a ranging rod or a bamboo stick at a convenient distance from the base line.
- Extend a straight line from the position of the first peg through the position of the bamboo stick .This gives a perpendicular line to the base line at the position of the first peg.

Pythagoras theorem method: Adopting a right angled triangle with the sides and hypotenuse in the proportions of 3:4:5, a perpendicular line can be drawn.



3, 4, 5 Method

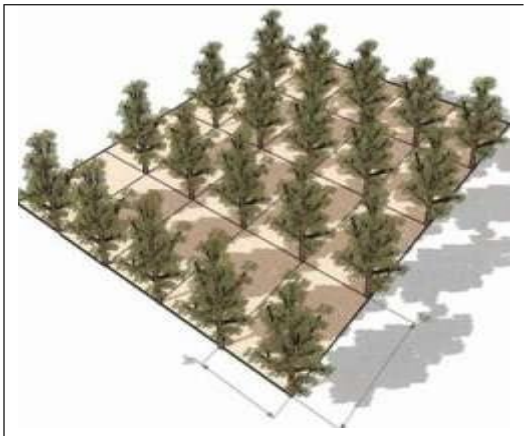
- On the base line from the first peg measure a known distance in proportion of3 and mark the point
- From the first peg, measure a distance in the proportion of 4 and draw an arc away from the base line.
- From the point previously marked on the base line now measure a distance in the proportion of 5 and draw a second arc intercepting the first one.
- Now extend a straight line from the position of the first peg through the point of intersection of the two arcs. This gives a

perpendicular line to the base linefrom the position of the first peg.

Merits and demerits:

1) Most commonly followed and simplest of all and easy to lay out.
2) The possibility of cultural operations in two directions is the greatest advantageof this system.
3) The major disadvantage of this system is that a lot of space in the centre ofeach square is wasted.

(2)Rectangular system:



- Similar to square system, except that the distance between plants in the row and distance between rows is not the same but different.
- Row to row distance is more than that from plant to plant in the row.

Procedure for lay out:

Step no's: 1, 2 and 3 are as same as in square system.

Step no.4: Mark the planting positions on both the perpendicular lines following thespacing to be adopted between the rows.

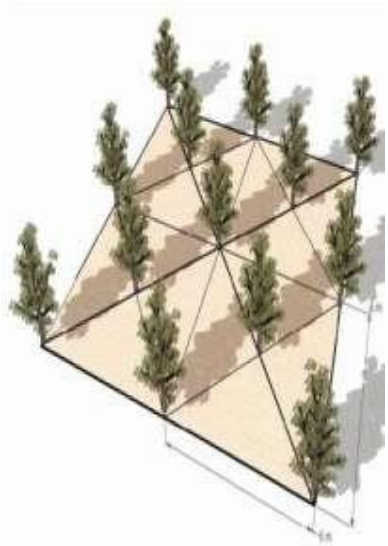
Step no.5: It is same as in square system, but following the spacing to be adjustedbetween the rows.

Step nos. 6, and 7 are as same as in square system.

Merits and demerits:

1. It has almost all the advantages of the square system but cultivation is some whatdifficult, especially when the trees have fully grown.

(3) Quincunx or Filler System:



- This is also known as filler or diagonal system.
- This is the modification of a square system of layout distinguished to make use of the empty space in the center of each square by planting another plant is called filler tree. Generally the filler tree will be precocious and shorter duration and not be of same kind as those planted on the corner of the square. Guava, phalsa. plum, papaya, peaches, kinnow are important fillers. They yield some crop before the permanent trees come into bearing.
- The filler tree is removed when the main fruit trees grow to full stature and start bearing.

This system is followed when the distance between permanent trees exceeds 8m or more or where permanent trees are very slow in their growth and also take longer time for coming to bearing. **Eg.** Sapota, Jackfruit**.**

Procedure for lay out:

Step no-1: Lay out the square system

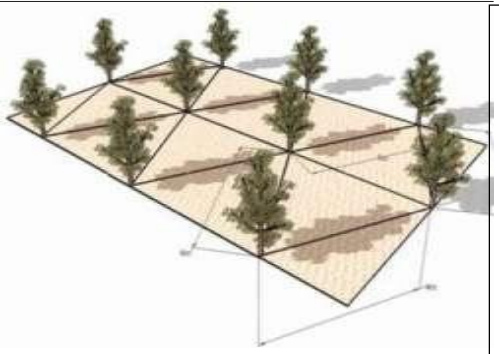
Step no.-2: Draw diagonals of each square.

Step no.3: Mark the planting position of the filler tree by fixing a peg at the point ofintersection of the two diagonals in each square.

Merits and Demerits:

1. The main advantage of this system is that the plant population is about double thanthe square system.
2. Demerits: it is difficult to carry outintercultural operations on account of the filler tree.

(4) Hexagonal system:



- This is also called as equilateral system. Some times a seventh tree is planted in the centre of the hexagon, and then it is called **septule** system.
- In this system the trees are planted in each corner of the equilateral triangle.
- This system differs from the square system in which the distance between the rows is less than the distance between the trees in a row, but the distance from tree to tree in six directions remains the same.

Procedure for lay out: Steps-

- Mark the four sides as in the case of square system with the distances shown in the sketch. Locate the positions of the plants also on the first row.
- Take a rope slightly more in length than double the distance between theplants.
- Put a knot in the centre, so that the length of the rope on either side of the knot is as much as the tree to tree distance **or**
- Take an iron chain with a ring in the centre and either arm equal in length to the tree to tree distance.
- Hold the ends of the rope or chain, each at the positions of two consecutive plants on the first row, and stretch from the centre to give an equilateral triangle and there by the position of a plant on the second row is fixed.
- In this way the field can be laid out.

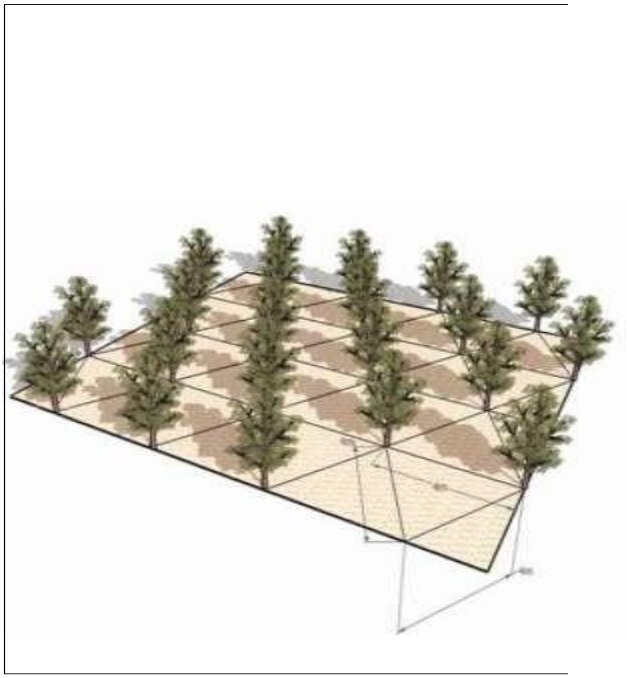
Merits and demerits:

1. This system permits cultivation in three directions.

2. **This system allows 15% more plants than the square system of planting.**

3. This system is not generally followed because it is difficult to adopt in practice in the field and the inter-cultivation in such gardens is difficult to carry out.

(5) Triangular system:



- The trees are planted as in square system but the difference being that those in the even numbered rows are midway between those in the odd rows instead of opposite to them.
- Triangular system is based on the principle of isolateral triangle. The distance between any two adjacent trees in a row is equal to the perpendicular distance between any two adjacent rows.

Merits and demerits:

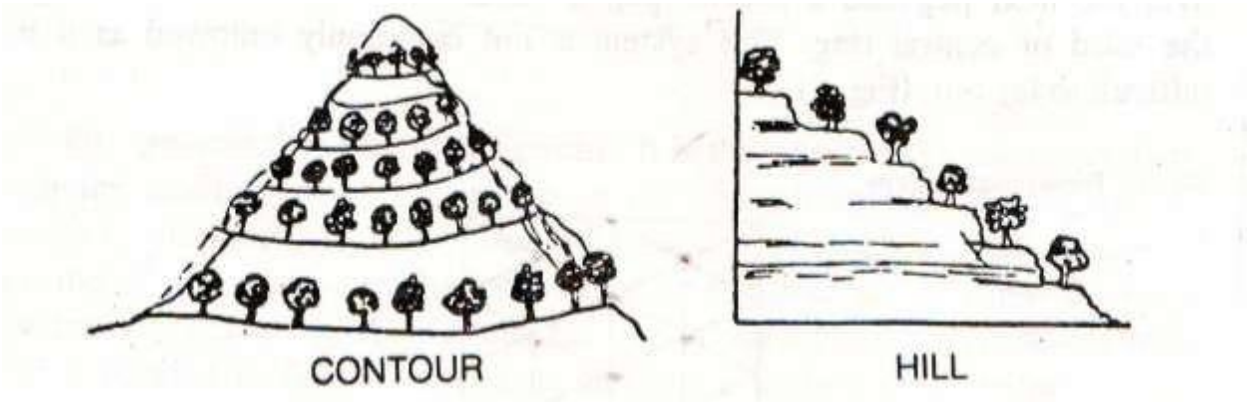
1. This system is not much of practical importance.

2. Plants are not placed at equal distance from all sides.

3. When compared to square system, each tree occupies more area and hence it accommodates few trees per hectare than the square system.

All the above systems are possible when the land is flat, plain or level, but not on uneven lands and sub-mountane areas (hilly areas).On undulating lands and hill slopes different types of planting systems are followed,Viz.,contour and terracing.

(6) Contour system or Terrace system



It is generally followed on the hills where the plants are planted along the contour across the slope.

- It particularly suits to land with undulated topography, where there is greater danger of erosion and irrigation of the orchard is difficult.
- 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.
- The contour line is so designed and graded in such a way that the flow of water in the irrigation channel becomes slow and thus finds time to penetrate into the, soil without causing erosion.
- 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.

Merits and demerits:

1) The trees may not be set at equidistance.

   The no. of plants per unit area will generally be less than other system

Calculation of the number of plants in different systems of planting

Square system of planting: $\frac{\text{Area of the land}}{\text{- Area occupied by a single tree}}$

Area of the land = 1 ha. (10000 sq. m^2) Spacing between the plants and rows =10 m

Area occupied by a single tree =10 m X 10 m=100 m^2 No. of plants required per hectare

$$= \frac{10{,}000\ m^2}{100\ m^2} = 100$$

Rectangular system: $\frac{\text{Area of the land}}{\text{- Area occupied by a single tree}}$

Area of the land = 1 ha. (10000 sq. $m^{2)}$ Spacing between the plants =10 m

Spacing between the rows =12 m

The area occupied by a single tree =10 m X 12 m=120 m^2

No. of plants required per hectare= $\frac{10{,}000\ m^2}{120\ m^2}$ = 88 plants.

Quincunx system: $\frac{\text{Area of the land}}{\text{Area occupied by a single tree}} \times 2$

(Double the no. of plants of a square system)

Area of the land = 1 ha. (10000 sq. m^2)

Spacing between the plants and rows =10 m

Area occupied by a single tree =10 m X 10 m=100 m^2

No. of plants required per hectare = $\frac{10{,}000\ m^2}{100} \times 2$

=200 plants.100 m^2

As the plants are planted additionally in the centre of the square, hence first, the no. of plants are calculated for square system of planting which is:

$$\frac{\text{Area of the land}}{\text{Area occupied by a single tree}}$$

$$= \frac{10000\ m^2}{10 \times 10m} = 100.$$

Additional plants = (No. of rows length wise –1) X (No. of rows width wise--1)

In 100x100 Sq metre field if planting distance 10x10 m then the number of rows lengthwise and width wise will be 10.

Hence, no of plants = (10-1) x (10-1) = 9x9=81.

So total no. of plants = plants planted in square system of planting + additionallyplanted plants in the center of the square =100+81=181.

$$\textbf{Hexagonal system} = \frac{\text{Area of the land}}{\text{Area occupied by a single tree}}$$

Method--1

Suppose plant to plant distance is 10m, then row to row distance will be calculated asunder:

ABC is equilateral triangle Hence

AB=AC=BC =10m

A perpendicular line AD is drawn on BC which divides it into two halves .It meansBD=DC=5m

As per Pythagoras therom

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

$AD^2= 10^2 - 5^2 =100-25=75.$

$AD= 75 = 8.66m^2$

Area occupied by a single tree is = Plant-to-plant distance x row-to-row distance

$=10x8.66=86.66\ m^2$

No. of plants per hectare = $\frac{10000\ m^2}{86.60\ m^2}$ = 115/116.

HIGH-DENSITY PLANTING / HIGH-DENSITY ORCHARDING

Planting of fruit trees rather at a closer spacing than the recommended one using certain special techniques with the sole objective of obtaining maximum productivity per unit area without sacrificing quality is often referred as 'High density planting' or HDP. 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. In this system, four planting densities are recognized for apples viz., low HDP (< 250 trees/ha), moderate HDP (250-500 tree/ha), high HDP (500 to 1250 trees/ha) and ultra high HDP (>1250 trees/ha). Recently, super high density planting system has been also established in apple orchards with a plant population of 20,000 trees per ha. In some orchards, still closer, planting of apple

trees is followed (say 70,000 trees/ha) which is often referred as 'meadow orchards'. The exact limits of plant density to be termed as is not yet well defined. It varies with the region, species, variety, rootstock, cost of planting material, labour and likelyreturn from the orchard and agro-techniques adopted for a particular crop.

High-density planting is one of the improved production technologies to achieve the objective of enhanced productivity of Indian fruit industry. Yield and quality of the produce are two essential components of the productivity. High density planting aims to achieve the twin requisites of productivity by maintaining a balance between vegetative and reproductive load without impairing the plant health.

The underlying principle of high-density planting is to make the best

use of vertical and horizontal space per unit time and to harness the maximum possible return per unit of inputs and national resources. In India, the usefulness/vitality of this technology has been proved in an array of fruit crops eg. pineapple, banana, papaya, mango, apple and citrus.

Advantages:

1) It induces precocity/precocious bearing
2) Higher yields. The average yield in apple is about 5.0 t/ha under normal systemof planting and it is about 140.0 t/ha under high density planting.
3) Higher returns per unit area
4) Early returns
5) Easy management of orchard tress
6) Reduces labour cost resulting in low cost of production
7) Enables the mechanization of fruit crop production and facilitates more efficientuse of fertilizers, water, solar radiation, fungicides, herbicides and pesticides.

Dis- advantages of high density planting:

1) HDP results in over crowding, over lapping not only in the tops, but also in the root system and heavy competition for space, nutrients and water.
2) More important is build up of high humidity, lack of cross ventilation in theorchard, which is more conducive for build up of pests and diseases.
3) Reduction in yield in the long run after 10-12 years of age.
4) Production of small sized fruits and poor quality fruits.