PRACTICAL MANUAL

ORCHARD AND ESTATE MANAGEMENT

Course No. HFS-301, Credits Hrs: 2(1+1)

Dr. Ranjit Pal

Dr. Anjana Kholia

2019

College of Horticulture& Forestry

Rani Lakshmi Bai Central Agricultural University

Jhansi - 284003

Syllabus:

Practical: Layout of different systems of orchard soil management, clean, inter, cover and mixed cropping, fillers. Use of mulch materials, organic and inorganic, moisture conservation, weed control. Layout of various irrigation systems.

Name of Student .....

Roll No. .....

Batch .....

Session .....

Semester .....

Course Name : .....

Course No. : .....

Credit .....

Published: 2019

No. of copies: ……..

Price: Rs.

©RLBCAU, Jhansi

CERTIFICATE

This is to certify that Shri./Km. .....ID No.....has completed the practical of course.....course No. ..... as per the syllabus of B.Sc. (Hons.) Agriculture/ Horticulture/ Forestry ..... semester in the year.....in the respective lab/field of College.

Date: Course Teacher

INDEX

Sl No.	Date	Exercise	Page No.	Remarks
1		To establish fruits Orchard		
2		To prepare layout of different planting systems of orchard - Square and Rectangular System		
3		To prepare layout of different planting systems of orchard - Diagonal or Quincunx system, Hexagonal systems, Triangular system and Double Row system		
4		To prepare layout of different planting systems of orchard- Contour and Terrace planting systems		
5		Orchard soil management- Clean cultivation in fruit orchard		
6		Orchard soil management- Inter-cropping in fruit orchard		
7		Orchard soil management- Cover cropping in fruit orchard		
8		Orchard soil management- Mixed cropping in fruit orchard		
9		Orchard soil management - Use of organic mulches in fruit orchard		
10		Orchard soil management - Use of inorganic mulches in fruit orchard		
11		Observations on soil moisture contents under mulches		
12		Observations on weed growth under different systems of management		
13		Management of weeds in fruits orchard		
14		Water management in fruits orchard		
15		To prepare layout of irrigation systems in fruit orchards - Surface Irrigation		
16		To prepare layout of irrigation systems in fruit orchards - Sub-surface Irrigation		
17		Production economics for commercial cultivation of fruit crops		
18		Visit to different fruit orchards		

Exercise No. 1

Objective: To establish Fruits Orchard

Write components of an Orchard: ……

Planting distance of different types of fruit crops

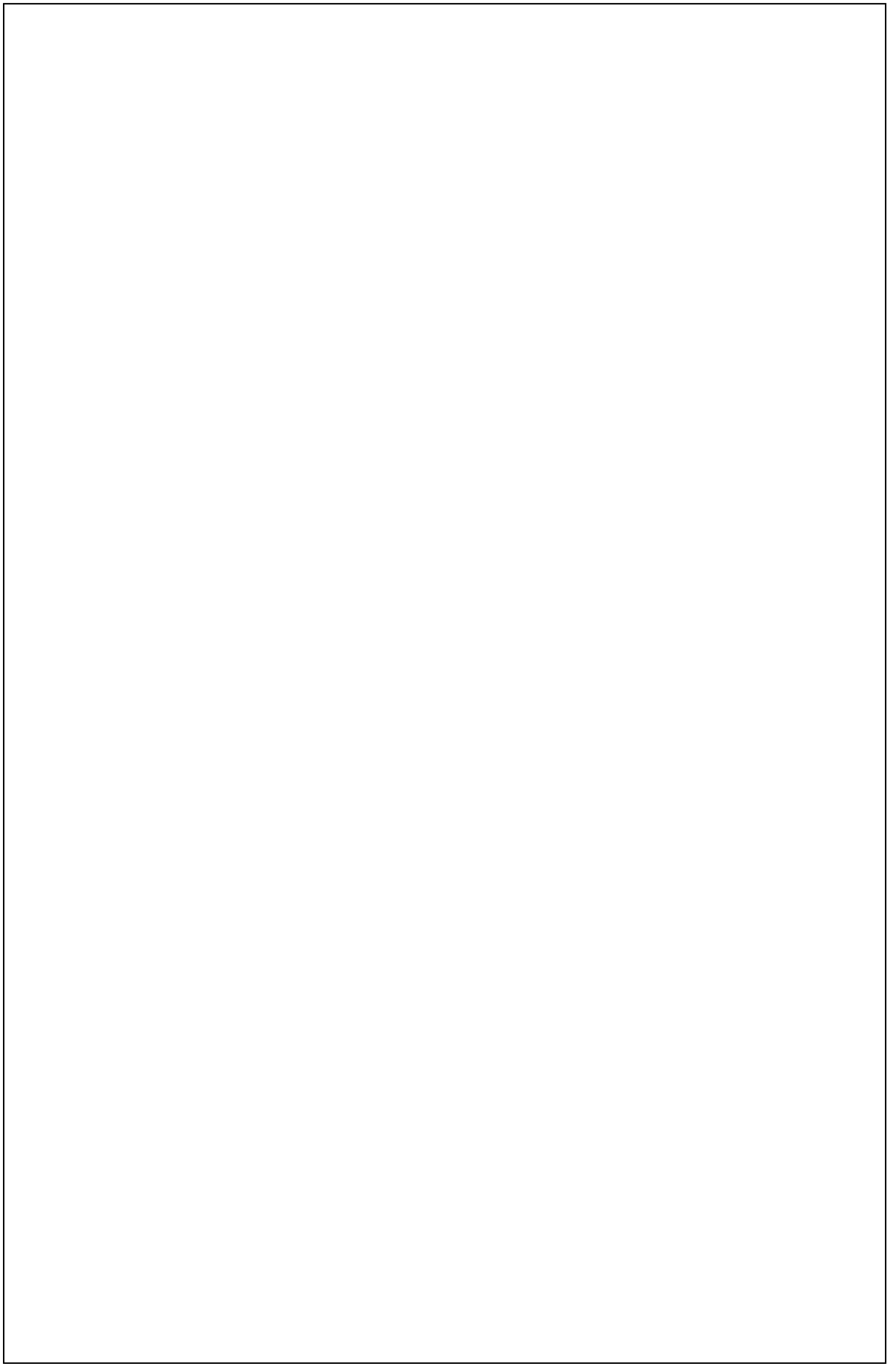
S. No.	Name of the Crops	Spacing (m) (Plant to Plant and Row to Row)
1.	Banana, Papaya	2-3 × 2-3
2.	Phalsa	3 × 3
3.	Passion fruit	3-4 × 3-4
4.	Pomegranate	3-6 × 3-6
5.	Custard apple	4-5 × 4-5
6.	Ber, Fig, Lemon	5-6 × 5-6
7.	Pumelo, Grapefruit	6-7 × 6-7
8.	Guava, Mulberry	6-8 × 6-8
9.	Persimmon	7-8 × 7-8
10.	Sapota, Avocado, Water apple, Rose apple	8-9 × 8-9
11.	Mandarin orange, Sweet orange	5 × 6
12.	Aonla, Bael	9-11 × 9-11
13.	Litchi	10-12 × 10-12
14.	Jackfruit, Mango, Jamun	12 × 12
15.	Pineapple	0.25 × 0.35 × 0.9
16.	Date palm	10 × 10
17.	Loquat	6 × 6
18.	Karonda	3-4 × 4-5
19.	Carambola	5 × 5
20.	Grape	2-3 × 3
21.	Apple (Non-spur type) Apple (Spur type)	6 × 6 4 × 4
22.	Pear	5 × 5
23.	Peach	5 × 5
24.	Palm	5 × 5
25.	Apricot	6 × 6
26.	Strawberry	Matted Rows: 40cm × 60cm Spaced Beds:30-50cm × 90-100cm Hill Rows: 30cm × 100cm
27.	Cherry	10 × 10
28.	Almond, Hazelnut	6 × 6
29.	Walnut	10 ×10
30.	Cashew Nut, Tamarind, Pecan Nut	12 × 12

Problem: Draw a neat sketch of an orchard (10.0 ha)

Material Required:

……
……
……

Name of the plants: ……
……
……
……
……



Exercise No. 2

Objective: To prepare layout of different planting systems of orchard - Square and Rectangular System

Materials Required: ……

……..

……..

Planting system: Vertical row planting pattern

Square System:

Procedure of lay out: ……..……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

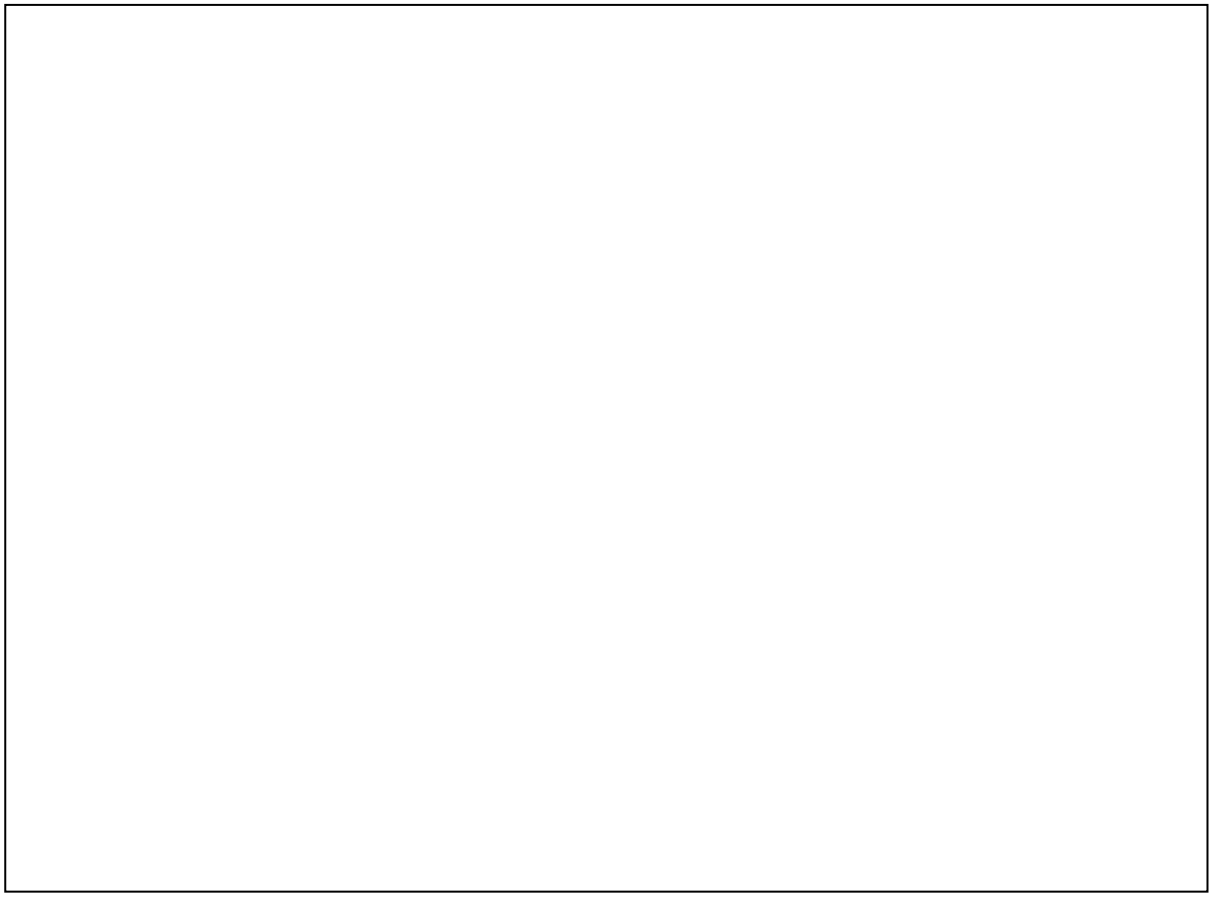
……..

……..

……..

……..

Rectangular system:



Procedure of lay out: ……..……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

Calculation of number of trees required per unit area

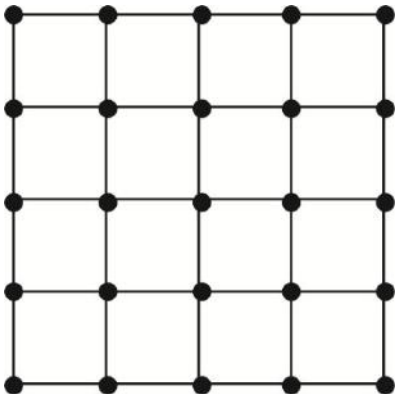
Calculation of number of different fruit crops per hectare with different system of planting by using the following formulae:

Square and rectangular systems:

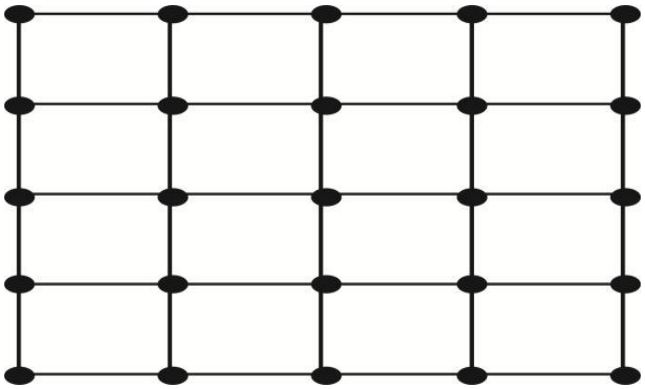
No. of plants required for 1 ha = 10, 000 sq. m
Row to row distance (m) × plant to plant distance (m)

No of plants / ha

$$\textbf{No of plants / ha} = \frac{\text{Total Area}}{(\text{Row to row distance}) \times (\text{Plant to plant distance})}$$



Square System



Rectangular system

Problem: ……
……..
……..
……..

Exercise No. 3

Objective: To prepare layout of different planting systems of orchard - Diagonal or Quincunx system, Hexagonal systems, Triangular system and Double Row system

Materials Required: ……

……..

……..

Alternate row planting pattern:

Diagonal or Quincunx system:

Procedure of lay out: ……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

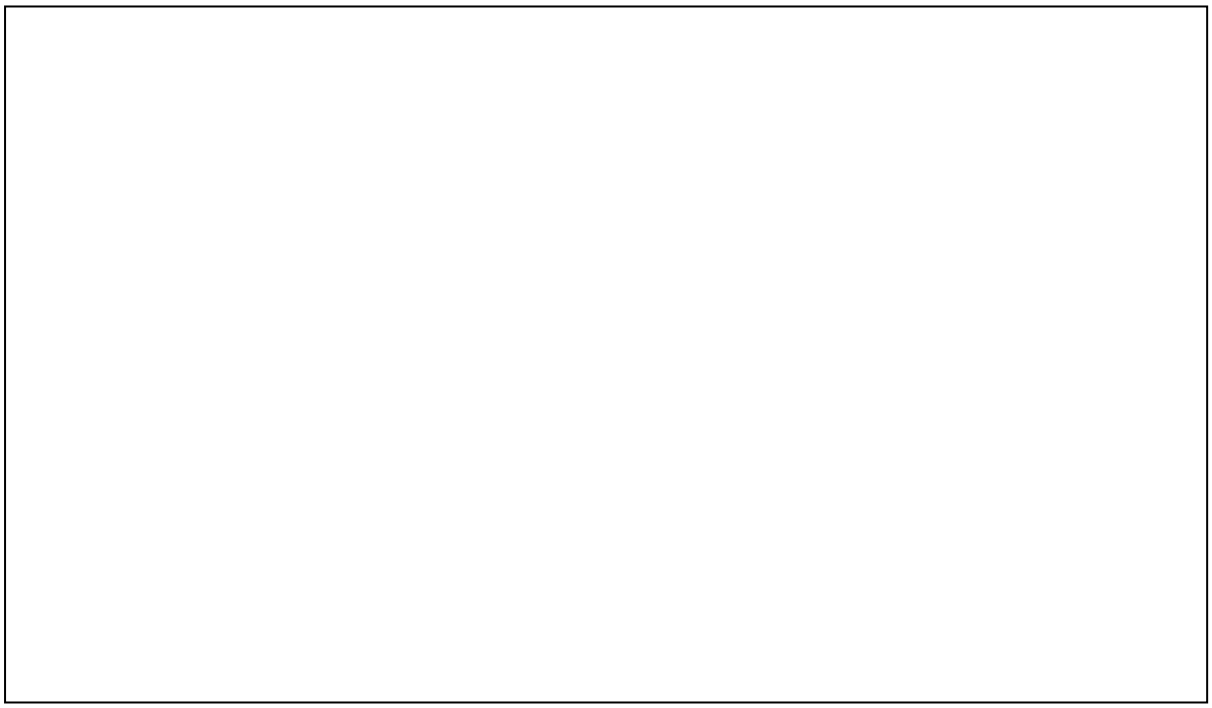
……..

……..

……..

……..

Hexagonal system:



Procedure of layout: ……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

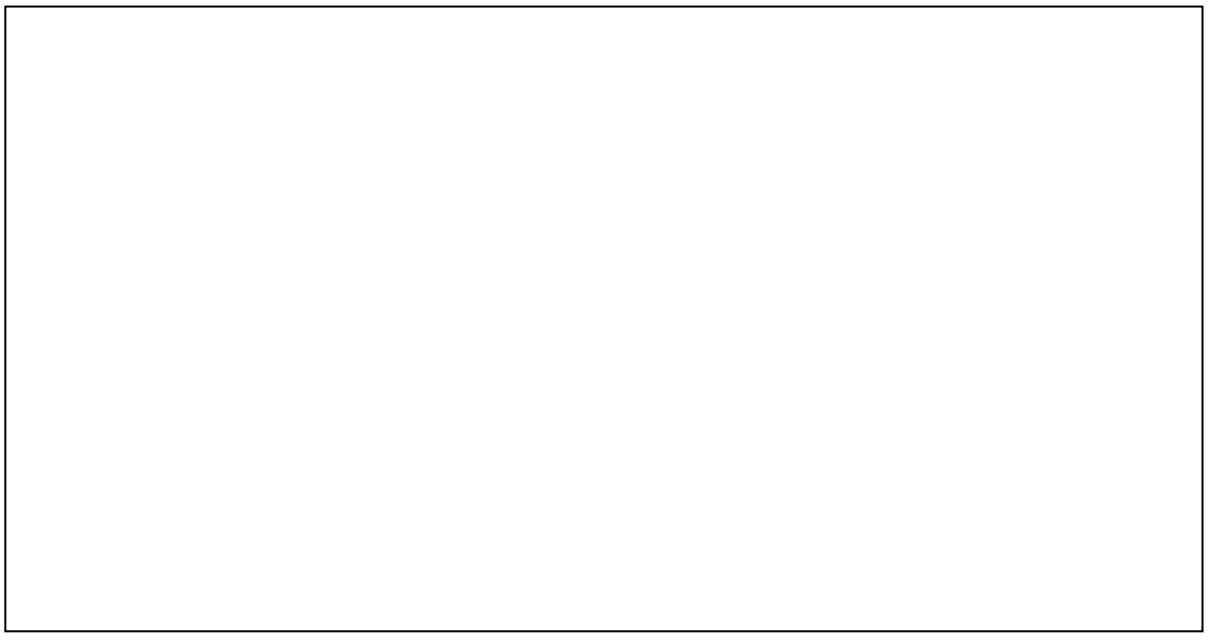
……..

……..

……..

……..

Triangular system:



Procedure of layout: ……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

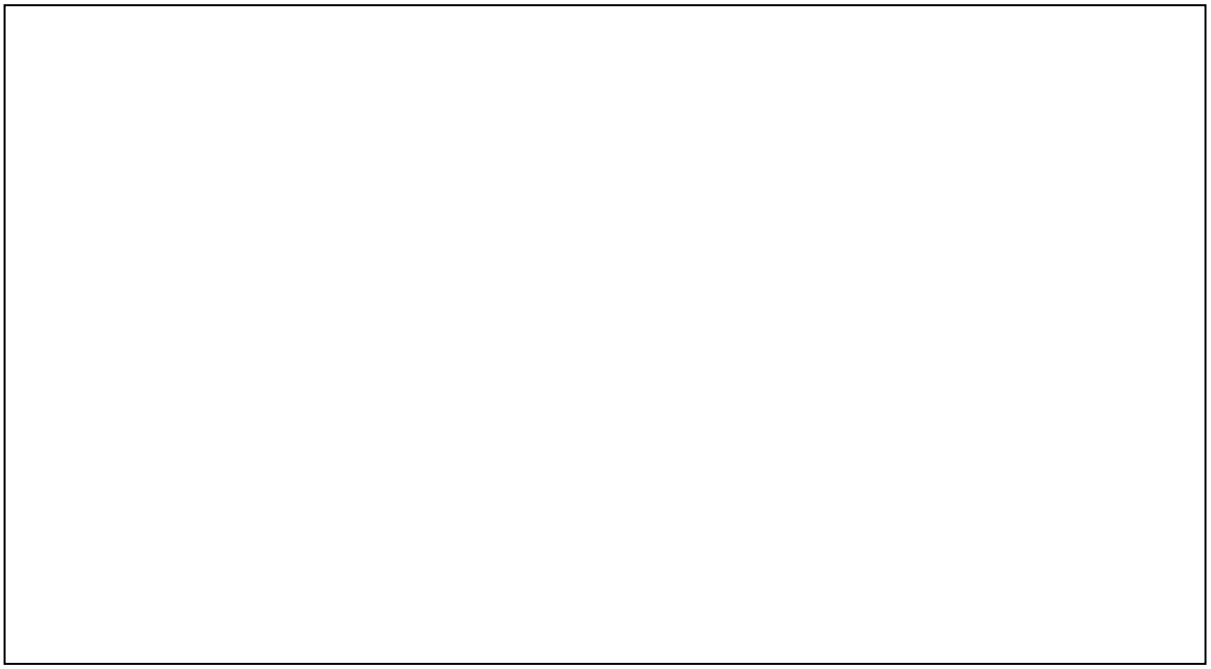
……..

……..

……..

……..

Double Row system:



Procedure of layout: ……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

……..

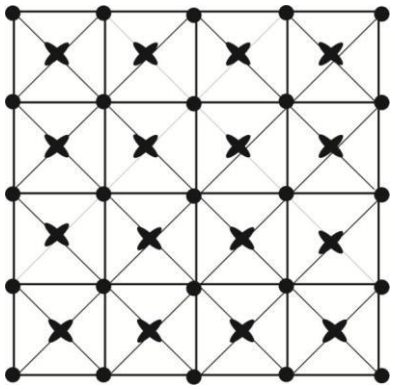
Calculation of number of trees required per unit area

Quincunx system

$$\textbf{No of plants / ha} = \frac{\text{Total Area}}{\text{(Row to row distance)} \times \text{(Plant to plant distance)}}$$

If Row to Row distance and Plant to Plant distance is 10m, then

$$\textbf{No of plants / ha} = \frac{10{,}000}{10 \times 10}$$



No. of Plants/ ha = 100

Additional plants planted in centre of square =

(No. of rows length wish – 1) × (No. of rows width wish – 1) =

(10– 1) × (10 – 1) = 9 × 9 = 81

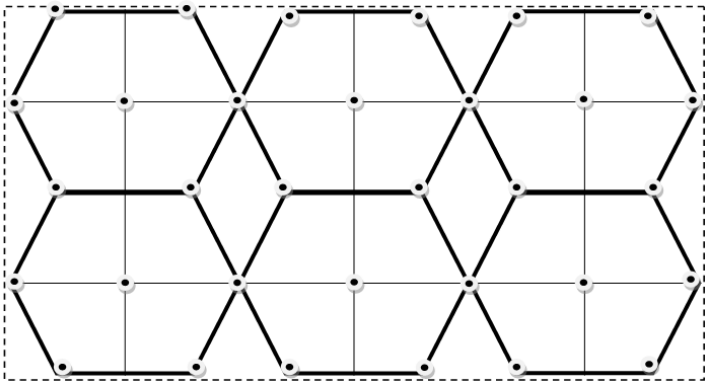
Therefore, total no. of plants = 100 + 81 = 181

Hexagonal system:

$$\textbf{No of plants / ha} = \frac{\text{Total Area}}{\text{(Row to row distance)} \times \text{(Plant to plant distance)}}$$

$$\textbf{No of plants / ha} = \frac{10{,}000}{10 \times 8.65}$$

No of plants / ha = 115



If plant to plant distance = 10 m, then as per equilateral triangles;

The row to row distance = AD=$\sqrt{AB^2 - BD^2}$

= $\sqrt{100 - 25}$

= 8.65 m

Triangular system:

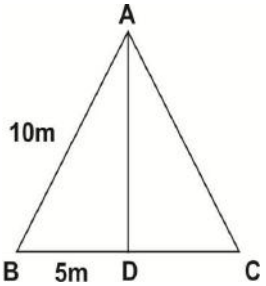
$$\textbf{P} = \frac{S}{d^2}$$

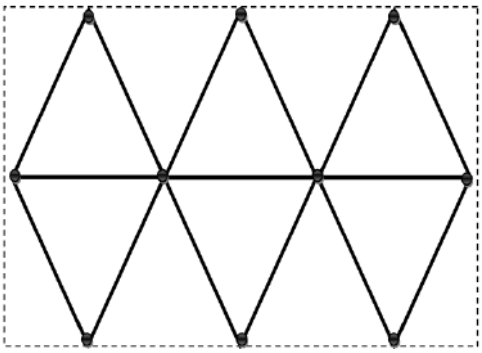
Where,

P= Plant population

S= Total Area

d= length of the triangle arm





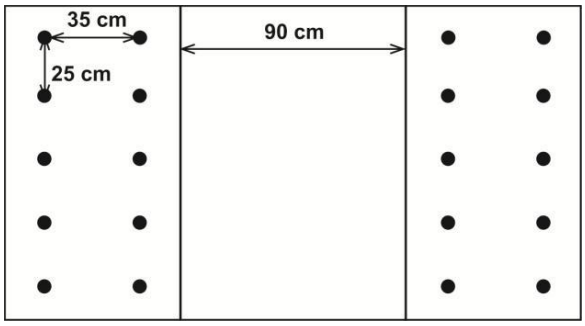
Double Row System:

No of plants / ha = $\dfrac{\text{Number of the Rows x Total area cropped}}{\text{(Plant to plant distance) × (Row to Row) + (Bed to Bed distance)}}$

If, the plant to plant distance is 25 cm, row to row distance is 35 cm and bed to bed distance is 90 cm.)

No of plants / ha = $\dfrac{2 \times 10000}{0.25 \times (0.35 + 0.90)}$

No of plants / ha = 64000



Observations to be performed:
Calculate of number of different fruit crops per hectare under different planting system.

Problem: Practice the planting system on the field and draw neat sketches

……..

……..

……..

……..

……..

……..

……..

……..

……..

……

……

……..

……..

……..

……..

……..

……..

……..

……..

……..

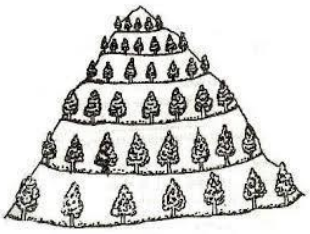
……..

……..

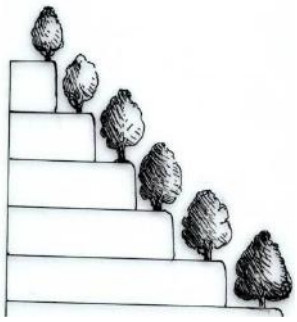
Exercise No. 4

Objective: To prepare layout of different planting systems of orchard- Contour & Terrace planting systems

Contour system



Terrace planting



Observations to be performed: Compare different systems of planting on sloppy lands with respect to number of trees accommodated in each, the initial growth performance, amount of moisture retained under canopy area.

Problem: Practice the planting system on the field and draw neat sketches of bench terrace and grade terrace.

……..

……..

……..

……..

Exercise No. 5

Objective: Orchard soil management - Clean cultivation in fruit orchards

Materials Required: ……

……..

……..

Procedure: ……

……

……..

……..

……..

……..

……..

……..

……..

……..

Precautions: ……

……

……..

……..

……..

……..

……..

……..

……..

……..

Observations to be performed:

- Count number (No/m^2) and dry weight of weeds (g/m^2) per unit area.
- Record soil moisture contents periodically.
- Record annual shoot growth, yield and average fruit weight.

Problem: ……

……

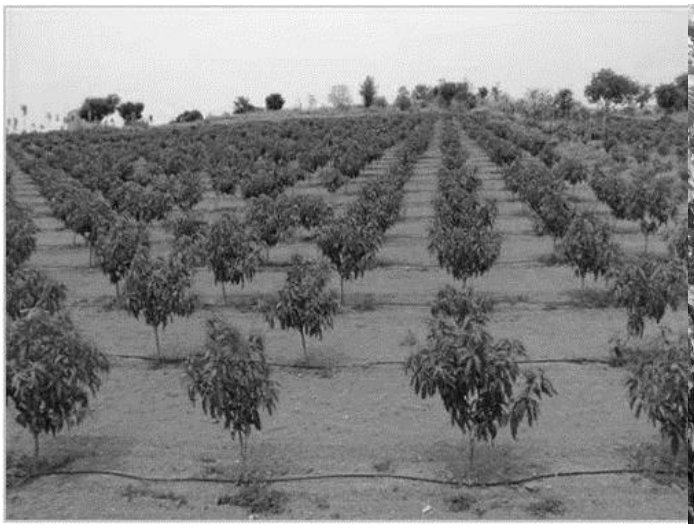
……..

……..

……..

……..

Clean cultivation practiced in plantation of pear and pomegranate



Clean cultivation practiced in plantation of Mango and passion fruit

Exercise No. 6

Objective: Orchard soil management- Inter-cropping in fruit orchard

Materials Required: ……

……..

Procedure: ……

……

……..

……..

……..

……..

……

……..

……..

……..

……..

……

……..

……..

……..

……..

Observations to be recorded: Record observations on the growth of fruit trees and work out the income from intercrop.

Problem: ……

……

……..

……..

……..

……..

……

……..

……..

……..

……..

……

Growing intercrop in fruits Orchard

Exercise No. 7

Objective: Orchard soil management - Cover cropping in fruit orchards

Materials Required: ……

……..

Procedure: ……

……

……..

……..

……..

……..

……

……..

……..

……..

……..

……

……..

……..

……..

……

Precautious: ……

……..……

……

……..

……..

……..

……..

……

Observation

1. Record soil organic matter contacts of the end of growing season of cover crops.
2. Take observation on number of weeds and dry weight of weeds on pr unit area basic.
3. Take observation on annual shoot growth, trunk girth, tree height and spread

Problem: ……

……..……

……

Exercise No. 8

Objective: Orchard soil management - Mixed cropping in fruit orchards

Materials Required: ……

……..

Procedure: ……

……

……..

……..

……..

……..

……

……..

……..

……..

……..

……

……..

……..

……..

……

Precautions: ……

……..

……

……..

……..

……..

Observations:

- Record yield of the component crops.
- Calculate income of the component crops separately.
- Calculate profit or loss of mixed crops as compared to single crop cultivation

Problem: ……

……

……..

……

……

Exercise No. 9

Objective: Orchard soil management - Use of organic mulches in fruit orchards

Mulching materials: ……

……

……

……

Procedure: ……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Precautions: ……

……

……

……

……

Observation to be taken

1. Record soil moisture contents and soil temperature of 15days internal from 30cm soil depth.
2. Count the number of weeds if any and record their dry weight.
3. Record soil organic matter contents of the end of season.

Problem: ……

……

……

……

Grass mulching in peach plantation

Grass mulching in Strawberry plantation

Exercise No. 10

Objective: Orchard soil management - Use of inorganic mulches in fruit orchards

Inorganic mulch materials: ……...

……..……

……..

Procedure: ……

……..……

……..

……..……

……..

……..……

……..

……..……

……..

……..……

……..

……..……

……..

Black polythene mulching in Apple plantation

White polythene mulching in Grapevine

Problem: ……

……..……

……..

……..……

Exercise No. 11

Objective: Observations on soil moisture contents under mulches

Method of determination: ……..

……..

……..

Materials required: ……

……..

……..

Procedure: ……

……..

……..

……..

……..

……..

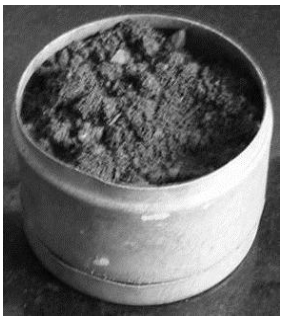
……..

……..

……..

……..

……..



Observations and calculations

Weight of empty moisture box, g = x
Weight of moisture box + oven dry soil, g = z
Weight of oven dry soil, g = (z – x)
Weight of moisture box + moist soil, g = y
Moisture content in soil, g = (y – z)
Per cent moisture in soil (w) = (y – z) × 100/(z – x)

Inference: Based on the average value of soil moisture content, draw inference of the effectiveness of different management system in conserving soil moisture.

Problem: ……..

……..

Exercise no. 12

Objective: Observations on weed growth under different systems of management

Materials required: ……

……

……

Procedure: ……

……

……

……

……

……

……

……

……

……

……

……

Weeds growth in the plant basin of pomegranate and acid lime

Note: Weed counts should be taken at monthly interval after laying out the management systems. Take three replicated observation under each system.

Problem: ……

……

……

……

……

……

……

Exercise No. 13

Objective: Management of weeds in fruits orchard

Materials required: ……..

……

……

Procedure of weed control: ……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Observations to be recorded: Observe critically the toxic effect of post emergence herbicide on different weeds and draw the inference.

Problem: ……

……

……

……

……

……

……

……

……

……

……

……

……

Exercise No. 14

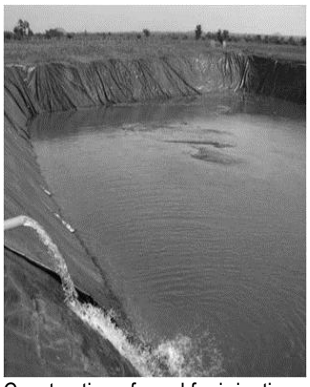
Objective: Water management in fruits orchard

Materials required: ……..

……

……

Grass mulching in pomegranate



Construction of pond for irrigation

Observations to be recorded: Record periodic observations on soil moisture contents under different systems of in-situ moisture conservation techniques and draw inference.

Problem: ……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Exercise No. 15

Objective: To prepare layout of irrigation systems in fruit orchards - Surface Irrigation

Materials required: ……..

……

Procedures:

Check basin: ……

……

……

……

……

……

……

……

……

Furrow method: ……

……

……

……

……

……

……

Basin system: ……

……

……

……

……

……

……

Modified basin system: ……

……

……

……

……

……

……

Calculation of water requirement of fruit plant: Water requirement of fruit plant can be calculating by employing evapo-transpiration technique. Under irrigation method, water is being replaced in the soil to compensate the loss. For this purpose, evapo-transpiration is calculated. The evapo-transpirational loss of water is treated as total water requirement of the plant. The requirement of water for a particular fruit crop is calculated by using the formula given below:

Water requirement (litres/day) = Pan evaporation (mm/day) × row to row spacing (m) × plant to plant spacing (m) × crop factor × Pan factor × percentage of wetted area.

Where;

Crop factor = 0.6
Pan factor = 0.7
Wetted area = 0.2-0.3

Suppose, if pan evaporation is 5 mm, row to row and plant to plant spacing is 6 meter, the water requirement would be then = 5 × 6 × 6 × 0.6 × 0.7 × 0.2 = 15.12 litres per day.

Observations to be recorded: Record water evapo-transpiration loss in the orchard by pan evaporation and accordingly work out water requirements of different fruit crops under traditional methods of irrigation.

Problem: Practice the job on the field and draw neat sketch

Exercise No. 16

Objective: To prepare layout of irrigation systems in fruit orchard - Sub-surface Irrigation

Materials required: ……..

……

……

Drip irrigation: ……

……

……

……

……

……

……

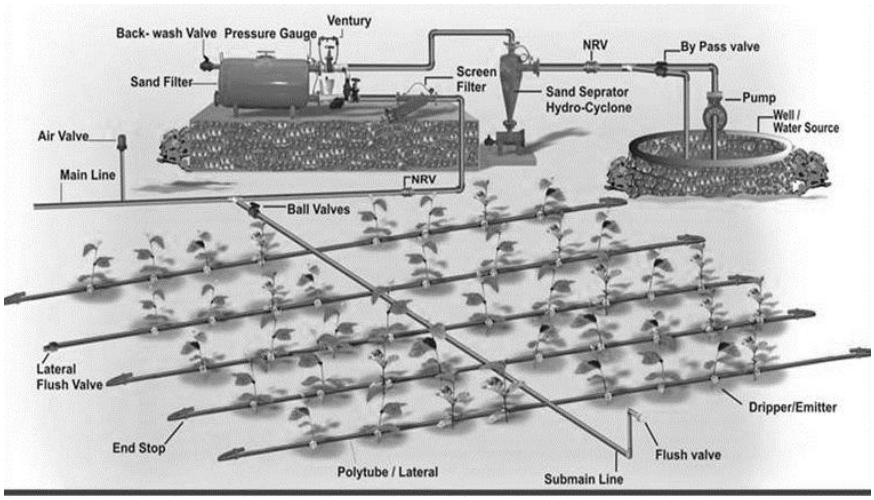
……

……

……

Types of drip irrigation systems:

- High pressure drip system. This operates at more than 30 psi pressure.
- Low pressure drip system. This operates at less than 30 psi pressure.



Water requirement of crops

Water requirement in litres per plant per day = r × f × k × c

Where,

r = Evaporation pan reading (mm)

f = Plant spacing (m^2)

k= Canopy constant

c= crop factor

Spreading canopy (m^2)

Canopy constant K

Plant spacing (m^2)

Crop factor for some crops are

Grapes---0.70; Citrus---0.60; Banana---0.85 (0.8 as an average for all plants)

Observations to be recorded: Record evapo-transpiration loss of water in the orchard by pan evaporation method and work out water requirement of fruit crop under drip irrigation system.

Problem: ……

……

……

EXERCISE No. 17

Objective: Production economics for commercial cultivation of fruit crops

Items for calculating the cost of cultivation for 1 ha. area

Sl. No.	Component	Proposed Expenditure
1.	**Plantation Expenses**	
	Cost of field preparation	
	Cost of planting material	
	Cost of Manures & fertilizers	
	FYM	
	Nitrogen	
	Phosphorus	
	Potassium	
	$FeSO_4$	
	$CuSO_4$	
	$FeSO_4$	
	Cost of any others nutrients and plant growth regulators	
	Cost of Insecticides & pesticides	
	Cost of labour for field preparation, planting, application of manures, fertilizers, pesticides, weeding and harvesting	
	Others, if any, (Power)	
2.	**Irrigation**	
	Tube-well/submersible pump	
	Cost of Pipeline	
	Others, if any, please specify	
3.	**Cost of Drip/Sprinkler**	
4.	**Infrastructure**	
	Store	
	Labour shed & Pump house	
	Farm Equipment	
5.	**Land Development**	
	Soil Leveling	
	Digging	
	Fencing	
	Others, if any, please specify	
Grand Total		

Total expenditure

Total yield of ……..

Sold @ ……..

Net income = gross income – expenditure

Net income growing one ha. will be …..

Benefit cost ratio: Net income / total cost

Calculation: ……..

……

……

……

……

……

……

……

……

……

……

……

Conclusion:

……..

……

……

……

……

……

……

……

……

……

……

……

……

……

……

The major components of the model are:

- **Land Development:** This is the labour cost of shaping and dressing the land site.
- **Fencing:** It is necessary to safeguard the orchard by a barbed wire fencing.
- **Irrigation Infra-structure:** For effective working with drip irrigation system, it is necessary to install a bore well with diesel/electric pumpset and motor. This is post cost of tube-well.
- **Drip Irrigation:** This is average cost of one-acre drip system for apple inclusive of the cost of fertigation equipment. The actual cost will vary depending on location, plant population and plot geometry.
- **Implements:** For investment on improved manually operated essential implements a provision of another Rs.15 thousand is included.
- **Building and Storage:** A one-acre orchard would require minimally a labour shed and a store-cum grading/packing room & pump house.

Exercise No. 18

Objective: Visit to different fruit orchards

Observations: ……...

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

.....