

SUBTROPICAL AND TEMPERATE FRUIT PRODUCTION

HFS 502, 3(2+1)

PRACTICAL MANUAL



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Course: Sub-tropical and Temperate Fruit Production, HFS-502, 3 (2+1)

Practical: Distinguished features of sub-tropical and temperate fruit species, cultivars and rootstocks. Demonstration of planting systems, training and pruning. Hands on practices on pollination and crop regulation. Leaf sampling and nutrient analysis. Water management and weed management Physiological disorders-malady diagnosis. Physiological disorders-malady diagnosis. Physico-chemical analysis of fruit quality attributes. Field/Exposure visits to tropical orchards. Project preparation for establishing commercial orchards.

Name of Students:

Roll No..... Batch.....

Session Semester.....

Course Name

Course No:..... Credit:

Certificate

This is to certify that Shri./Km.

ID No: has completed the practical of courses

..... courses No

..... as per the syllabus of M. Sc (Horticulture)

Fruit Science.....semester in year

..... in the respective lab/field of college.

Date:

Course Teacher

CONTENTS

S. No	Title of the Exercise	Signature
1.	To study the morphological characters of sub-tropical fruits: Citrus and Pomegranate	
2.	To study the morphological characters of temperate fruits: Apple and Strawberry	
3.	To study the morphological characters of important fruit varieties	
4.	To study the establishing of high-density fruits orchard	
5.	Layout of planting systems of orchard	
6.	To study the training and pruning of subtropical fruits	
7.	To study the floral biology of subtropical fruits	
8.	To study the pollination of subtropical fruits	
9.	To study the crop regulation of Pomegranate/Citrus	
10.	To study the leaf sampling and phosphorus analysis of tropical fruits	
11.	To identify and management of nutritional disorders in subtropical and temperate fruit crops	
12.	To study the analyses of quality attributes of TSS and Acidity	
13.	To study the analyses of sugar content & vitamins	
14.	To visit to Drip irrigation unit	
15.	To study the weed management in fruits orchard	
16.	To study the mapping of agri export zones of India	
17.	To study the production economics for commercial cultivation of fruit crops	
18.	To visit to commercial orchards and diagnosis of maladies	

Exercise No: 1

Objective: To study the morphological characters of sub-tropical fruits: Citrus and Pomegranate

Materials required:

1. Citrus spp

A. General parameters

- i. Common name:
- ii. Botanical name:
- iii. Type of planting material (Seedling/grafted/layered):
- iv. Name of the variety:
- v. Name of the rootstock:
- vi. Age of the plant:
- vii. Parentage name:

Observation:

Parameters	Remarks
Tree height	
Tree habit	
Tree shape	
Petiole wing shape	
Leaf or leaflet shape	
Time of flowering	
Flower type	
Arrangement of flowers	
Inflorescence position	
Fruit shape	
Fruit base shape	
Fruit apex shape	
Fruit length and width (cm)	
Fruit weight (g)	
Quality characters	

2. Pomegranate

A. General parameters

- i. Common name:
- ii. Botanical name:
- iii. Type of planting material (Seedling/grafted/layered):
- iv. Name of the variety:
- v. Age of the plant:
- vi. Parentage name:

Observation:

Parameters	Remarks
Tree height (cm)	
Tree spread (cm)	
Tree habit	
Inflorescence type and position	
Main flowering season	
Duration of flowering	
Number of hermaphrodite and male flowers per plant	
Physical characters of fruit	
Maturity index	

Exercise No: 2

Objective: To study the morphological characters of temperate fruits: Apple and Strawberry

Materials required:

1. Apple

A. General parameters

- i. Common name:
- ii. Botanical name:
- iii. Type of planting material (Seedling/grafted/layered):
- iv. Name of the variety:
- v. Age of the plant:
- vi. Parentage name:

Observation:

Parameters	Remarks
Plant height (cm)	
Plant girth (cm)	
Bearing habit	
Number of flower buds per inflorescence	
Flowering time	
Physical parameters of Fruit	
Maturity period:	
Maturity index:	

2. Strawberry:

A. General parameters

- i. Common name:
- ii. Botanical name:
- iii. Type of planting material:
- iv. Name of the variety:
- v. Age of the plant:
- vi. Parentage name:

Observation:

Parameters	Remarks
Tree height (cm)	
Tree spread (cm)	
Flower:	
Fruit:	
Maturity Period:	
Maturity index:	

Exercise No: 3

Objective: To study the morphological characters of important fruit varieties

Materials required:

1. Mandarin:

Kinnow:

Daisy Mandarin:

Nagpur Mandarin:

William Murcott:

2. Sweet Orange:**Mosambi:****Sathgudi:****Jaffa:****Blood Red:**

3. Acid lime:**Kagzi lime:****Pramalini:****NRCC-8:****Chakradhar****Balaji:**

4. Grape fruit and Pummelo

Red Blush:

Marsh Seedless:

Flame grape fruit:

US-145:

NRCC Pummelo-5:

5. Rootstock

Alemow:

Rangpur lime:

Rough lemon:

Carrizo citrange:

Cleopatra mandarin:

6. Pomegranate:**Bhagwa:****Ganesh:****Jalore Seedless:**

7. Apple:

8. Strawberry:

Exercise No: 4

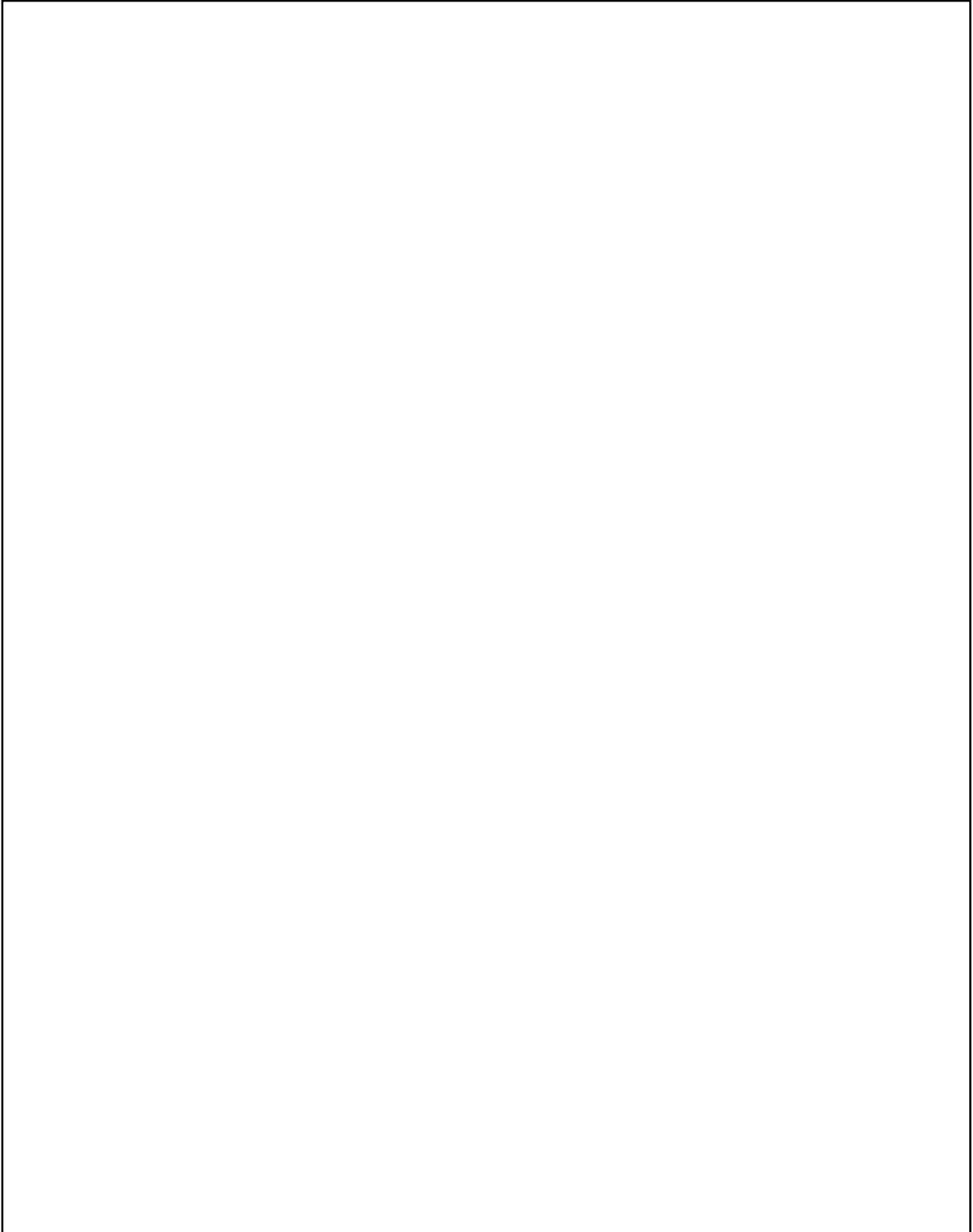
Objective: To study the establishing of high-density fruits orchard

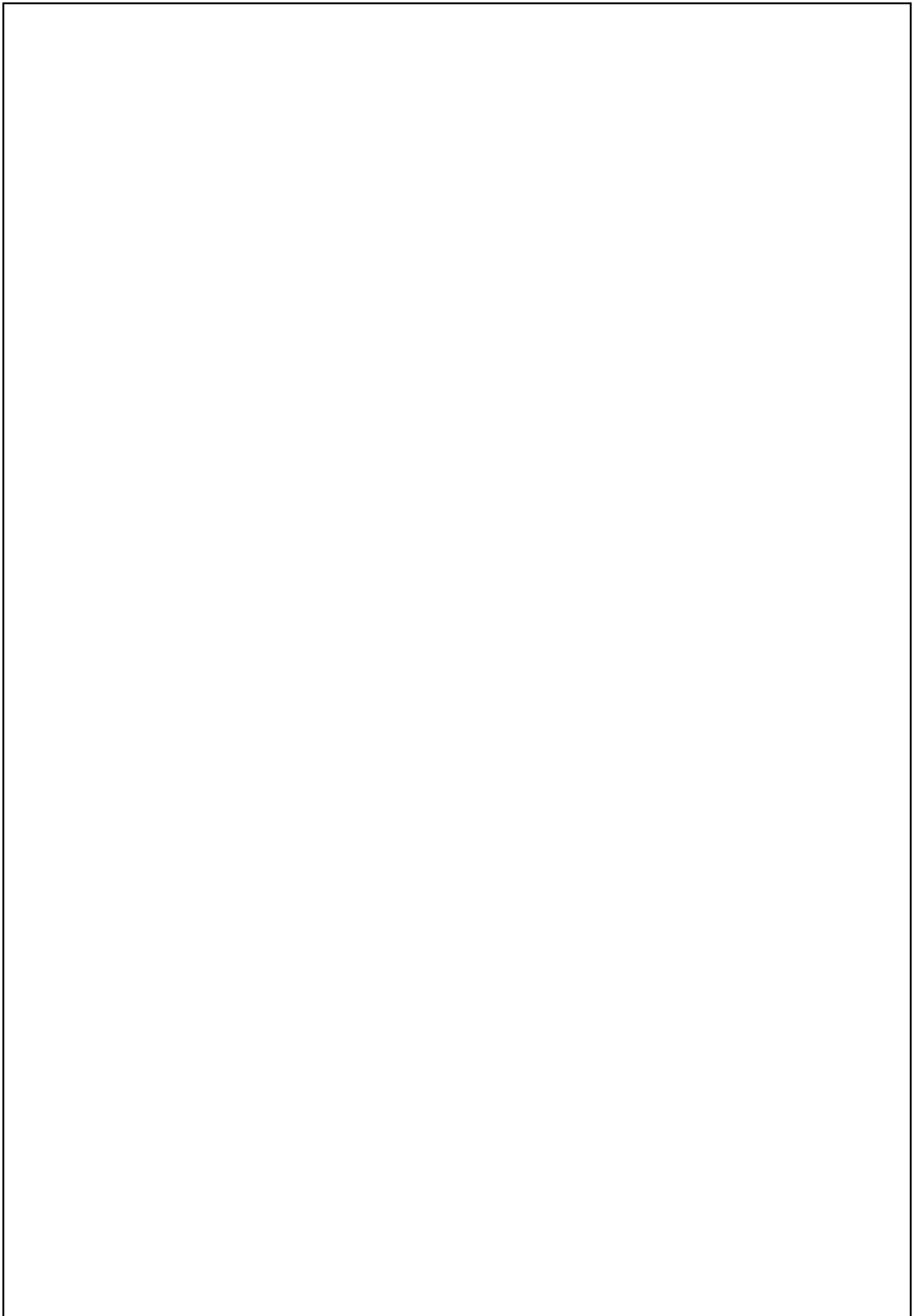
Materials required:

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Important Features/Components of HDP Orchard





Problem: Draw a neat sketch of an orchard (5.0 ha)

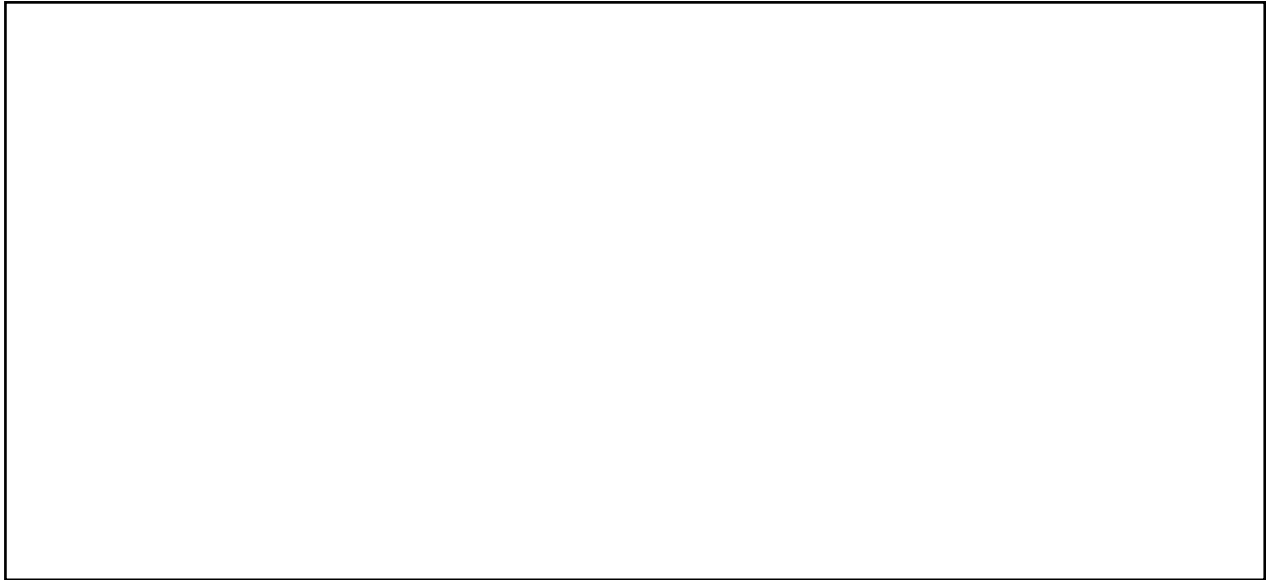
Objective: Layout of planting systems of orchard

Materials required:

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Planting system: Contour and Terrace system



Procedure of lay out:

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

Objective: To study the training and pruning of subtropical fruits

Materials required:

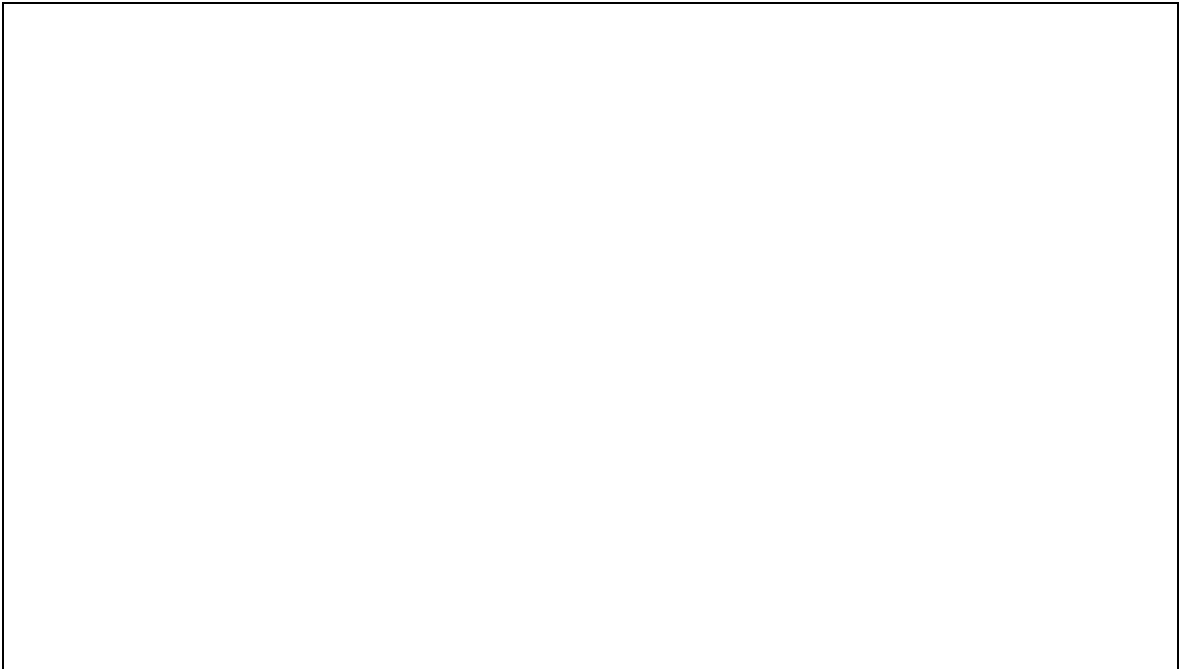
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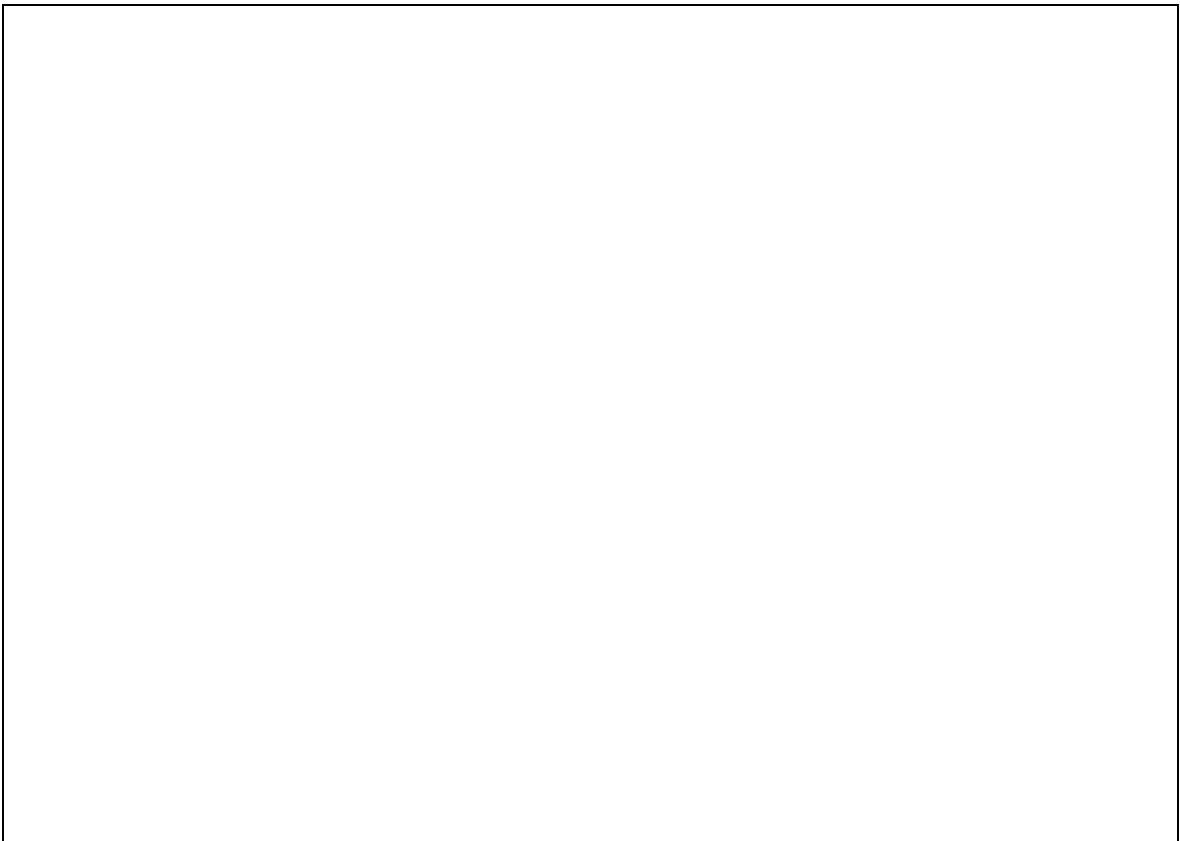
Methods of training system:

Procedures of training system:

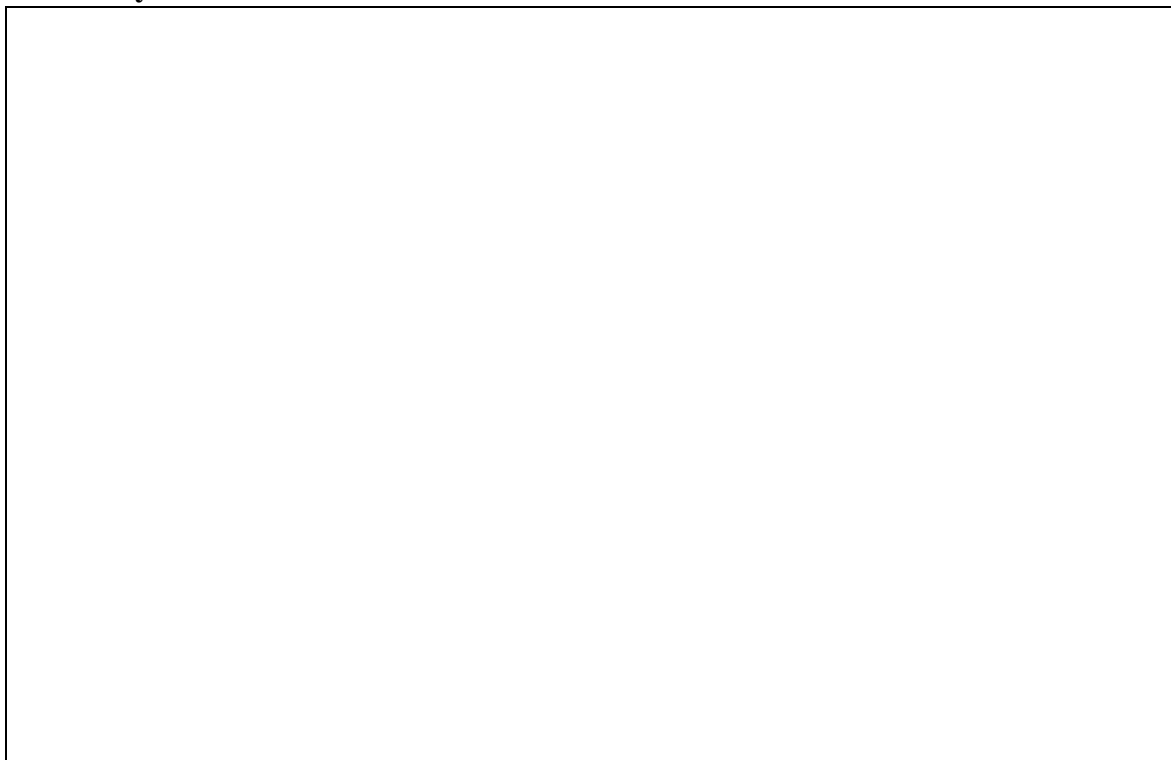
A. Bower system



B. Tatura trellis



C. Y trellis system



Procedure of pruning

Assignment: Practice different system of training and pruning

Objective: To study the floral biology of subtropical fruits

Materials required:

Flowering stage:

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Procedure:

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Exercise No: 8

Objective: To study the pollination of subtropical fruits

Materials required:

Procedure:

Observation: Record the number fruit

Date	Female Parent	Male Parent	Date of pollination	Fruit set (yes/No)

Exercise No: 10

Objective: To study the leaf sampling and phosphorus analysis of tropical fruits

The digested plant sample will be used for the phosphorus determination in plant samples. Ammonium molybdate and ammonium metavanadate helps to develop color and the color intensity is measured by the spectrophotometer at 470 nm wavelengths.

Collection of plant sample procedure:

(A). Digestion of plant sample

Reagents required:

Wet digestion (Di-acid or tri-acid mixture):

Procedure for plant digestion:

(B). Phosphorus analysis from digested sample

Reagents required:

TOTAL PHOSPHORUS IN PLANT SAMPLE

Digestion of plant material

Reagents

- Concentrated nitric acid (AR Grade)
- 60% HClO₄ (AR Grade)
- Approximately 2 NHCl (AR Grade)

Wet digestion (Di-acid digestion): Wet ash of plant samples can be done by a tri-acid mixture (HClO₄ + H₂SO₄ + HNO₃; 3:1:10) or a di-acid (HClO₄ + HNO₃; 3:10) digestion excluding H₂SO₄. Exclusion of H₂SO₄ permits the use of same extract for S

Procedure

- ✓ Weigh 0.5 to 1.0 g of dried plant sample in a 100 ml Erlenmeyer flask.
- ✓ Add 10 ml of concentrated HNO₃, place a funnel on the Erlenmeyer flask and keep for about 6-8 hours for pre-digestion.
- ✓ Add 10 ml of HNO₃ and 2-3 ml of HClO₄,
- ✓ Place the Erlenmeyer flask on a hot plate kept in an acid proof digestion chamber having a fume exhaust system, heat at 100°C for 1 hour and then raise the temperature to 200°C.
- ✓ Continue digestion until the contents become colour less and only dense fumes appear.
- ✓ Continue heating at 200°C until the contents are reduced to 2-3 ml. Do not allow to dry up. Remove the Erlenmeyer flask from hot plate, cool and add 10 ml of 2 N HCl.
- ✓ Warm the contents of the Erlenmeyer flask and filter through Whatman nor 42 filter paper into a 100 ml volumetric flask. Give 3-4 washings of 15-20 ml.
- ✓ Make up the volume to 100 ml.
- ✓ Estimate P content in the digest as per section

For Phosphorus estimation

Reagents

- ✓ Ammonium metavanadate solution (0.25%): Dissolve 2.5 g of ammonium metavanadate in 500 ml of boiling water, add 20 ml of concentrated HNO₃ and dilute it to 1 litre and store in an amber glass bottle.
- ✓ Ammonium molybdate solution (5%): Dissolve 25 g of ammonium molybdate in 400 ml distilled water (warmed to 50°C). Cool the solution and make up the volume to 500 ml and filter if cloudy. Store in an amber color glass bottle.
- ✓ Nitric acid (HNO₃) solution (5M): Dilute 530 ml concentrated HNO₃ of Sp. 1.42 to 1 litre.
or
- ✓ **Mixed reagent:** Dissolve 50.0 g ammonium molybdate and 2.5 g ammonium metavanadate in 500 ml of warm distilled water separately in two beakers. Cool them and mix in a two litre volumetric flask and add 500 ml concentrated HNO₃ cool it to make up the volume with distilled water to two litres.
- ✓ Standard P solution (100 ppm): Dissolve 0.4390 g dried KH₂PO₄ in 400 ml distilled water, add 25 ml of 7 N H₂SO₄ and make upto 1 litre.

Procedure

- ✓ Take 5 ml extract in a 50 ml volumetric flask (0, 2.5, 5.0, 7.5 and 10 ml of standard p solution).
- ✓ Add 5 ml 5 N HNO₃ and 5 ml 0.25% ammonium metavanadate solution and mix thoroughly.
- ✓ Now add 5 ml of 5% ammonium molybdate solution, mix and make up the volume. (Or add 10 ml of mixed reagent).
- ✓ Read the transmittance or absorbance at 470 nm wavelengths on a spectrophotometer set at zero with reagent blank.
- ✓ Find out the concentration of P in solution at the spectrophotometer reading so obtained from the standard curve prepared from the readings for standard solution.
- ✓ Run a reagent blank and make necessary adjustments.

Exercise No: 12

Objective: To study the analyses of quality attributes of TSS and Acidity

Materials required for estimation of total soluble solids (TSS):

Procedure:

Observations:

Samples	Name of crops:	TSS (° Brix)

Conversion of the reading of the refractometer with scale indicating Sucrose for a temperature different from 20±0.5°C

Temperature °C	Scale reading for soluble solids content (%)													
	5	10	15	20	25	30	35	40	45	50	55	60	65	70
	Subtract from actual reading													
15	0.29	0.31	0.33	0.34	0.34	0.35	0.36	0.37	0.37	0.38	0.38	0.39	0.39	0.40
16	0.24	0.25	0.26	0.27	0.28	0.28	0.29	0.30	0.30	0.30	0.31	0.31	0.32	0.32
17	0.18	0.19	0.20	0.21	0.21	0.21	0.22	0.22	0.23	0.23	0.23	0.23	0.24	0.24
18	0.13	0.13	0.14	0.14	0.14	0.14	0.15	0.15	0.15	0.15	0.16	0.16	0.16	0.16
19	0.06	0.06	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
	Add to actual reading													
21	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
22	0.13	0.14	0.14	0.15	0.15	0.15	0.15	0.14	0.16	0.16	0.16	0.16	0.16	0.16
23	0.20	0.21	0.22	0.22	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24
24	0.27	0.28	0.29	0.30	0.30	0.31	0.31	0.31	0.31	0.31	0.32	0.32	0.32	0.32
25	0.35	0.36	0.37	0.38	0.38	0.39	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
26	0.42	0.43	0.44	0.45	0.46	0.47	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48
27	0.50	0.52	0.53	0.54	0.55	0.55	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
28	0.57	0.60	0.61	0.62	0.63	0.63	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
29	0.66	0.68	0.69	0.71	0.72	0.72	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73
30	0.74	0.77	0.78	0.79	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81

Source: Proceeding of the ninth session of the International Commission for Uniform Methods of sugar analysis, London, 1936.

Materials required for estimation of sugar:

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Procedure:

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Calculation:

$$\text{Total sugar as invert sugars (\%)} = \frac{\text{Factor} \times \text{Dilution}}{\text{titre} \times \text{weight of sample taken}} \times 100$$

$$\% \text{ Sucrose} = (\% \text{ total invert sugars} - \% \text{ reducing sugars}) \times 0.95$$

$$\% \text{ Total sugars} = (\% \text{ reducing sugars} + \% \text{ sucrose})$$

Materials required for estimation of ascorbic acid:

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Procedure:

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Calculation:

$$\text{Ascorbic acid (mg/100 g)} = \frac{\text{Titre} \times \text{Dye factor} \times \text{volume made up}}{\text{Aliquot of extract taken} \times \text{Weight of sample taken}} \times 100$$

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ii. **Main Line:**.....

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iii. **Submain line:**

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iv. **Laterals:**

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v. **Emitters or Drippers:**

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vi. **Controls Valves (Ball Valves):**

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vii. **Flush Valve:**

viii. **Air Release Cum Vacuum Breaker Valve:**

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ix. **Non-Return Valve:**

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x. **Pressure Gauge:**

xi. **Gromate and Take-off:**

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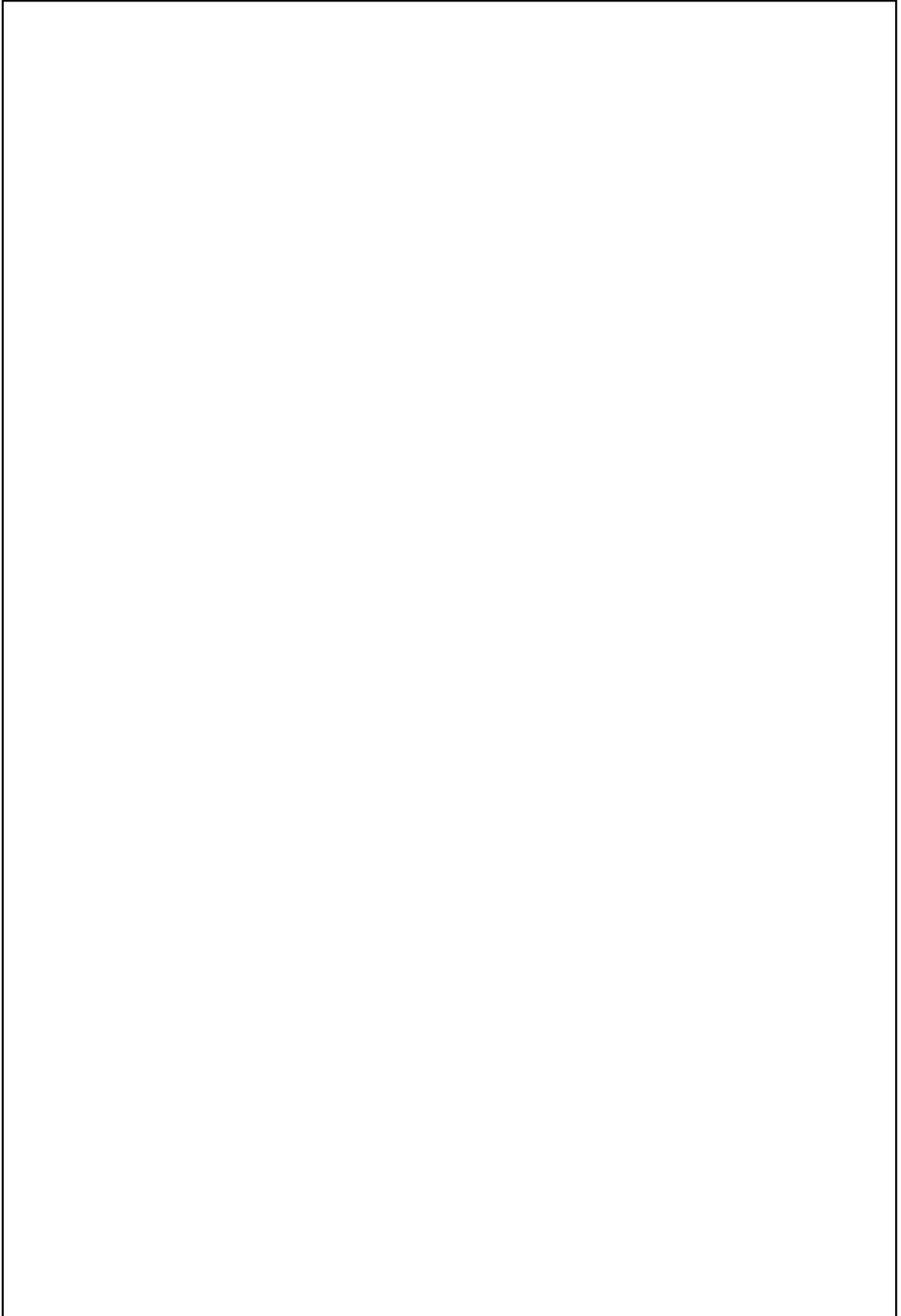
xii. **End Caps (End Sets):**

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xiii. **Fertilizing System:**

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Layout:



Exercise No: 15

Objective: To study the weed management in fruits orchard

Materials required:

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Procedure:

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Observation

Particulars	Description
About herbicide	
Trade name	
Quantity of formulated product for a given area and crop	
Stage of application	
About requirement	
Name of equipment	
Working condition	
Type of nozzle	
Walking speed	
Spray volume for given area	

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

Objective: To study the mapping of agri export zones of India

Materials required:

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List of major subtropical and temperate fruits grown region in India:

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State wise description of Agri-export zones in India:

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Assignment: Draw sketches of Indian political map and mansion agri-export zones. Point out major fruits producing area and production.

Exercise No: 17

Objective: To study the 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

Net income = gross income – expenditure

Total yield of

Sold @

Net income growing one ha. will be

Benefit cost ratio: Net income / total cost

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: To visit to commercial orchards and diagnosis of maladies

Materials required:

Procedure of observation

