



# Canopy Management in High Density Orchards of Temperate Regions



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# Canopy Architecture Management

**A series of operations on the above ground portion of the plant, aiming towards maximized production of quality fruits per unit canopy area.**





# Canopy Architecture Management...

**Appropriate canopy architecture management encompasses the development of**

- **Strong frame of primary branches**
- **Wider crotches in scaffold branches**
- **Healthy and well distributed secondary and tertiary branches**
- **Sufficient fruiting terminals in most productive areas**
- **Healthy foliage with high photosynthetic efficiency to maximize the solar radiation use efficiency**
- **Enough space for air circulation inside canopy**



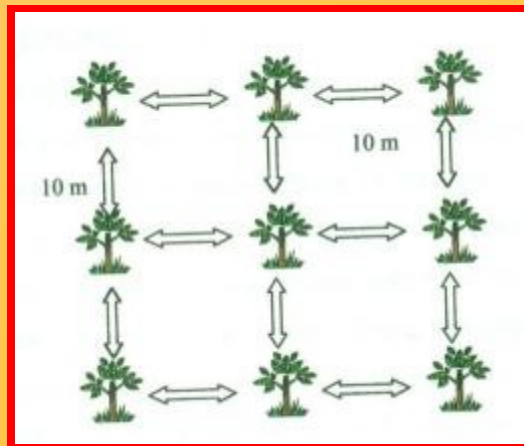
# Inherent plant characteristics

- Growth behavior
- Flushing pattern
- Dormancy pattern
- Bearing behavior



# Set of conditions and resources

- Planting system
- Spacing etc.
- Solar radiation
- Wind velocity
- Rainfall pattern
- Light distribution



# Principles of Canopy Architecture Management

- **Facilitating aeration inside the canopy**
- **Maximizing light penetration in and outside of canopy**
- **Facilitating conversion of sunlight into chemical energy by plant leaf**
- **Controlled plant structure including stature**
- **Improved fruit colour, quality and yield**





# Understanding Architectural behavior of plants

**Before, going for canopy management, understanding of plant nature and behaviour i.e. Plant architecture is essential**

**Because,**

- **The architecture of a plant depends on the nature and relative arrangement of its each part.**
- **The expression of an equilibrium between endogenous growth process and exogenous constraints exerted by the environment**



# How to decide the course of action for Canopy Architecture Management ?

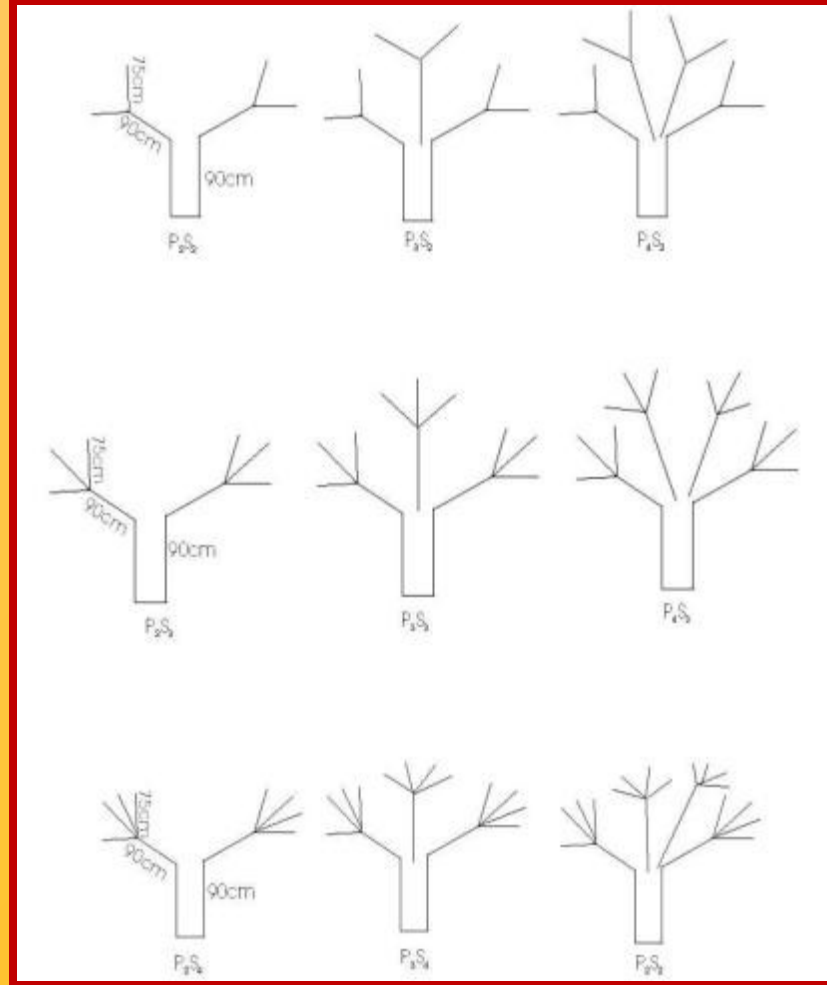
1. Analysis of architectural engineering concepts in plant, such as
    - Angling of branches
    - Pattern of branching
  2. Understanding the endogenous growth process like
    - Flushing pattern
    - Action of growth hormones
- 
1. Understanding the level of influence of environment on architecture at a point of time/ location
  2. Objectives for which canopy is being managed



# Basic Objectives of Canopy Architecture Management

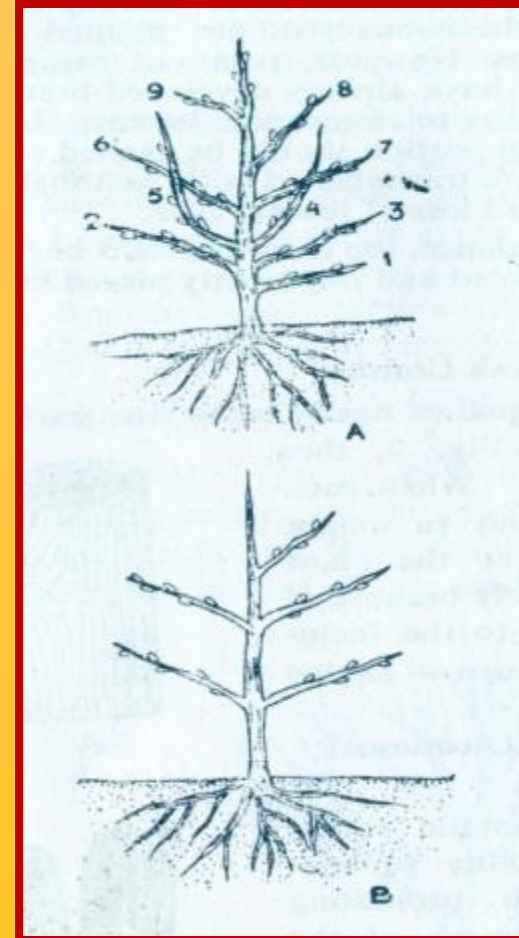


- **To restore root/ shoot ratio**
- **To obtain specific form of the plant**
- **To develop specific geometry within the plant and its overall topology**
- **To maintain optimum balance between vegetative and reproductive parts**



# Few Considerations for Canopy management

- **Plants respond differentially in different environment**
- **Development of shoot and root system in the plant has symbiotic relationship**

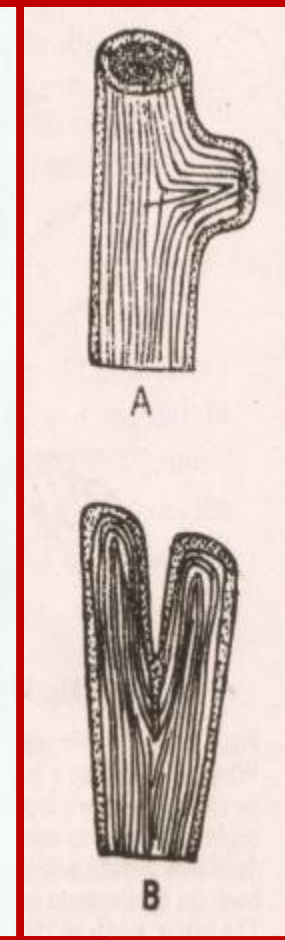
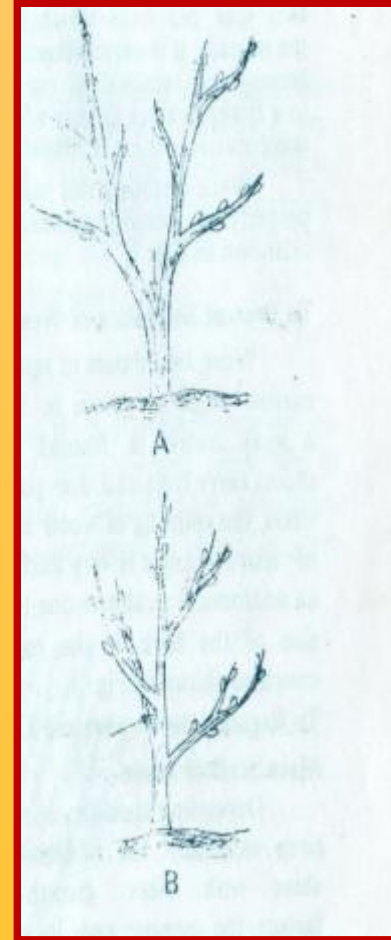


**Restore root / shoot ratio**



# Few Considerations for Canopy management

- **Weak crotches in the branches and direction of the branches can be corrected by unequal cuttings**



**Schematic diagram of angling of branches and formation of wider crotches**

# Few Considerations for Canopy management

- Pruning is a dwarfing process

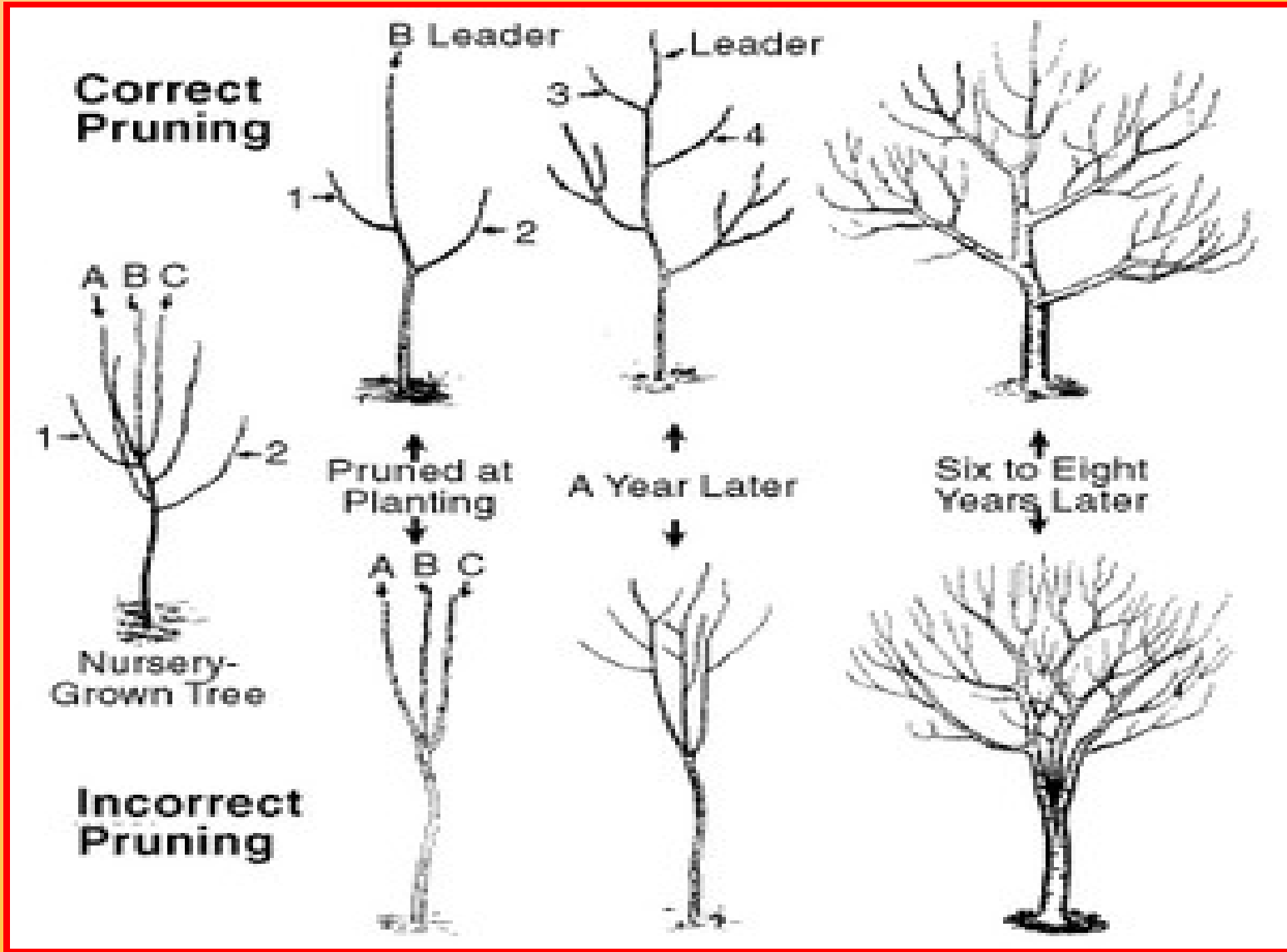


Pruning for  
dwarfing and  
promotion  
maximum shoots/  
fruiting  
points

- Vegetative growth and fruiting/yield have antagonistic effects
- Apical dominance is a natural phenomenon

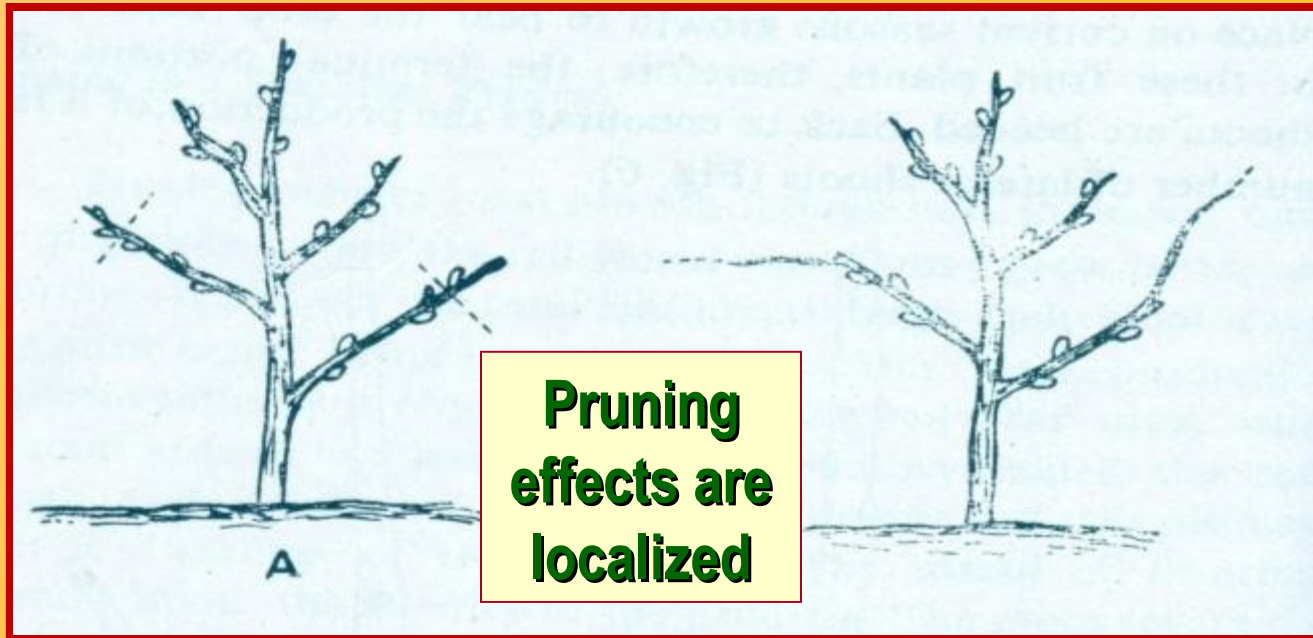


# Plant architecture development by Pruning



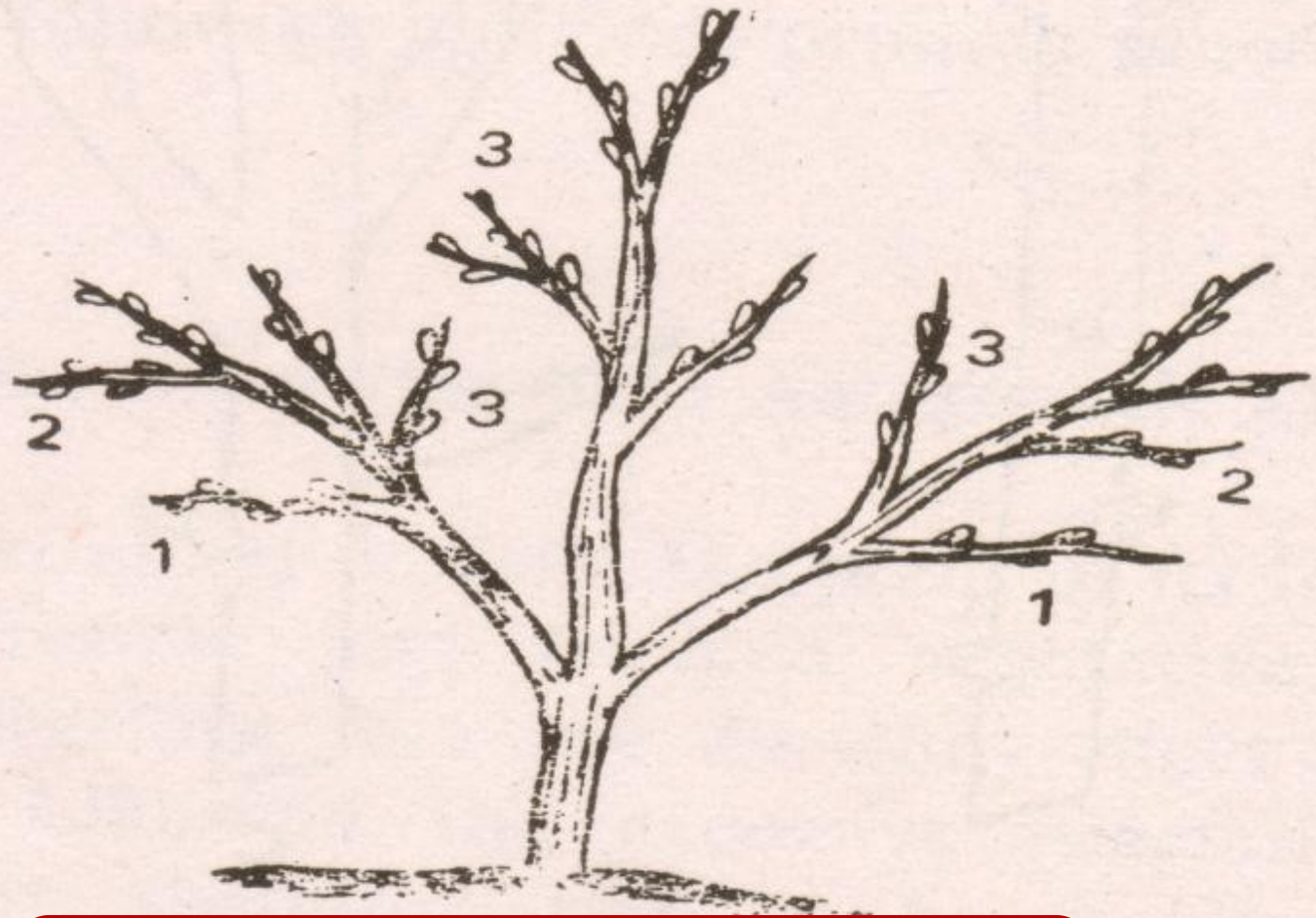
# Few Considerations for Canopy management

- Vigour of shoots varies inversely with their number and crop load
- Fruit quality is affected by heavy cropping
- Pruning effects are localized



Growth stimulation in the bud next to cut

# Few Considerations for Canopy management



By cutting outside (1,2) or inside buds (3),  
the trees can be made to spread or grow compact

# Few Considerations for Canopy management



- **Young shoots afford the best material for blossom bud formation**



- **Removal of shoot results in loss of accumulated carbohydrate**



# Steps of Canopy management

- **Selecting appropriate planting system**
- **Initial frame development**
- **Training the plants with open centre**
- **Centre opening of grownup trees**
- **Allow the canopy to grow horizontally**
- **Pruning of the shoots and excessive growth**



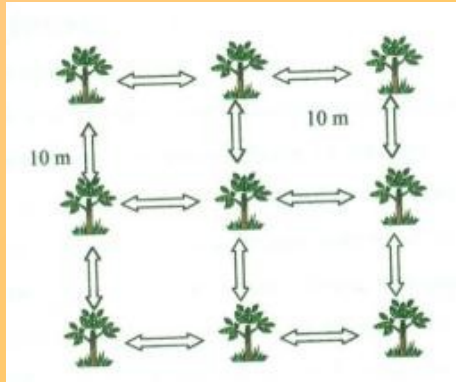
# 1. Planting System

Major advances in planting system are

- Square system with high density planting
- Rectangular system with high density planting
- Double hedge row
- Single canopy with multiple root system

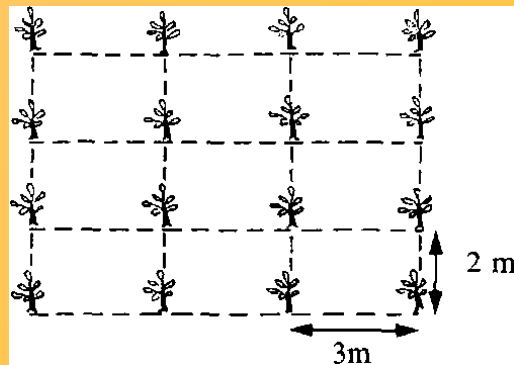


# Planting System

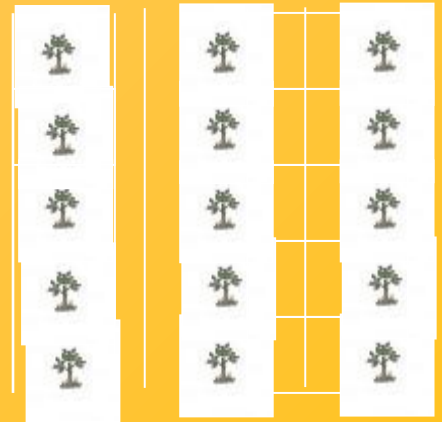
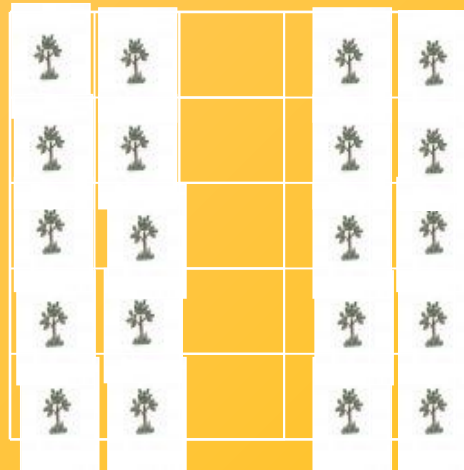


**Square system**

**Rectangle system**



**Double hedgerow**



**Single hedgerow**

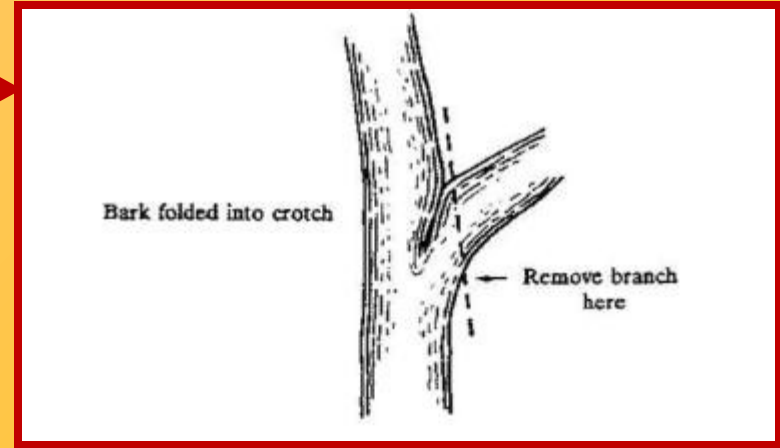
# View of single row system of planting in apple



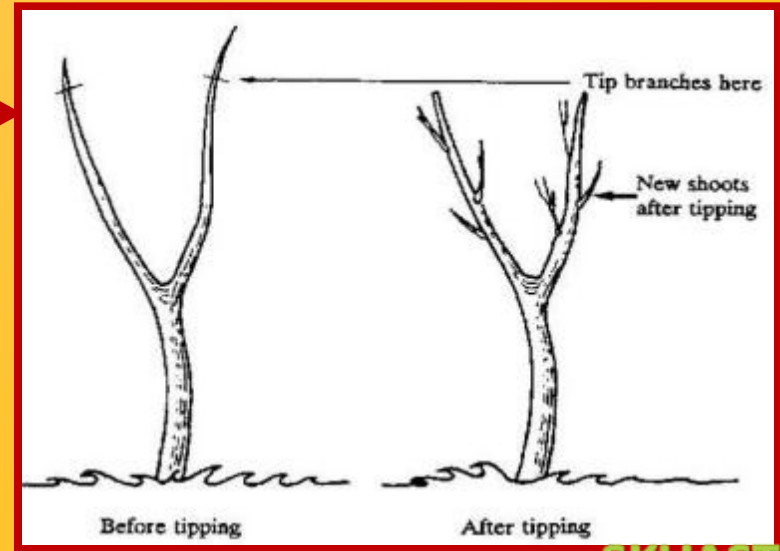
# 2. Frame Development

Process for frame development in subtropical fruits are

**a) Removing weak crotches**



**b) Tip pruning of long branches / breaking apical dominance to facilitate laterals**



# 3. Developing open centre frame work in Apple

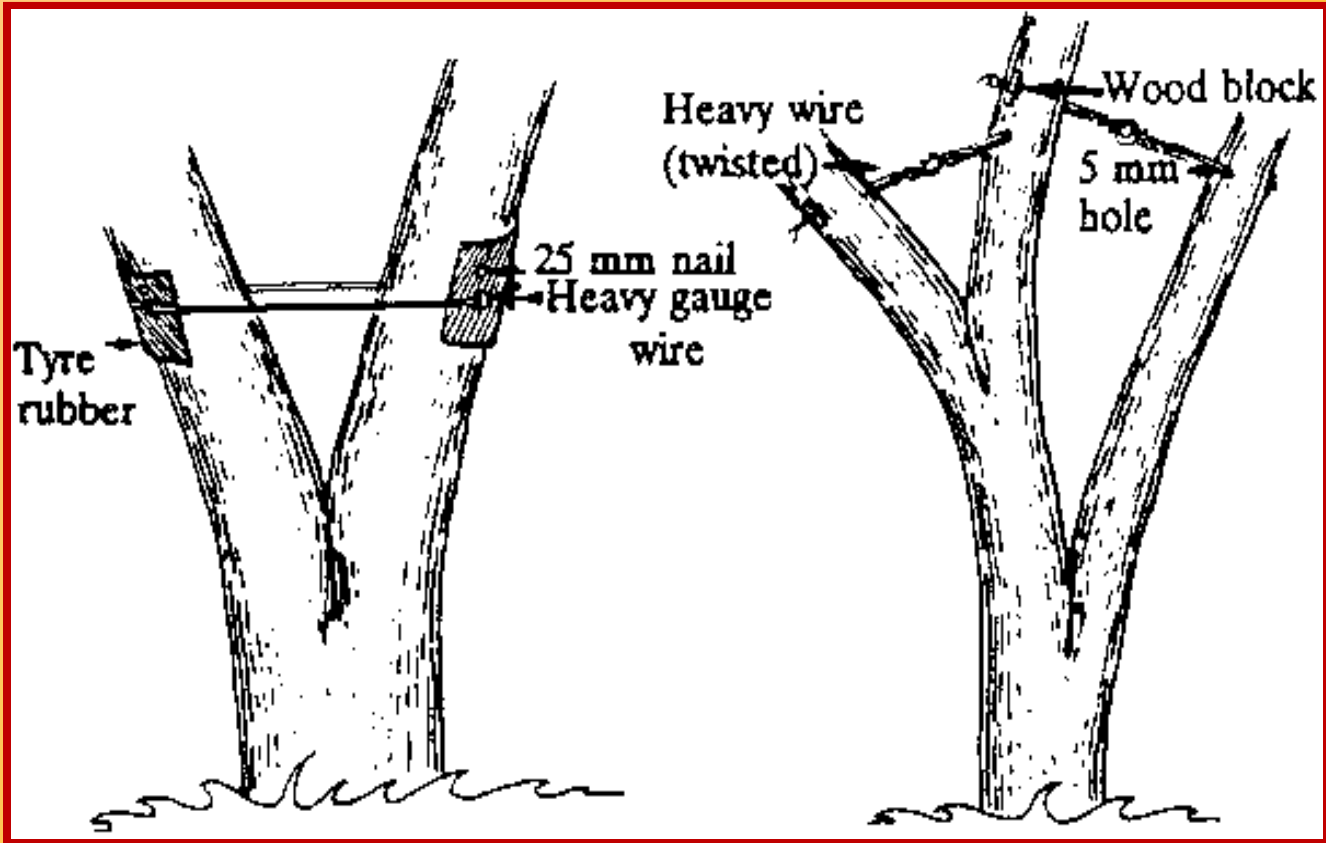


1



2

# Considerations for Frame Development

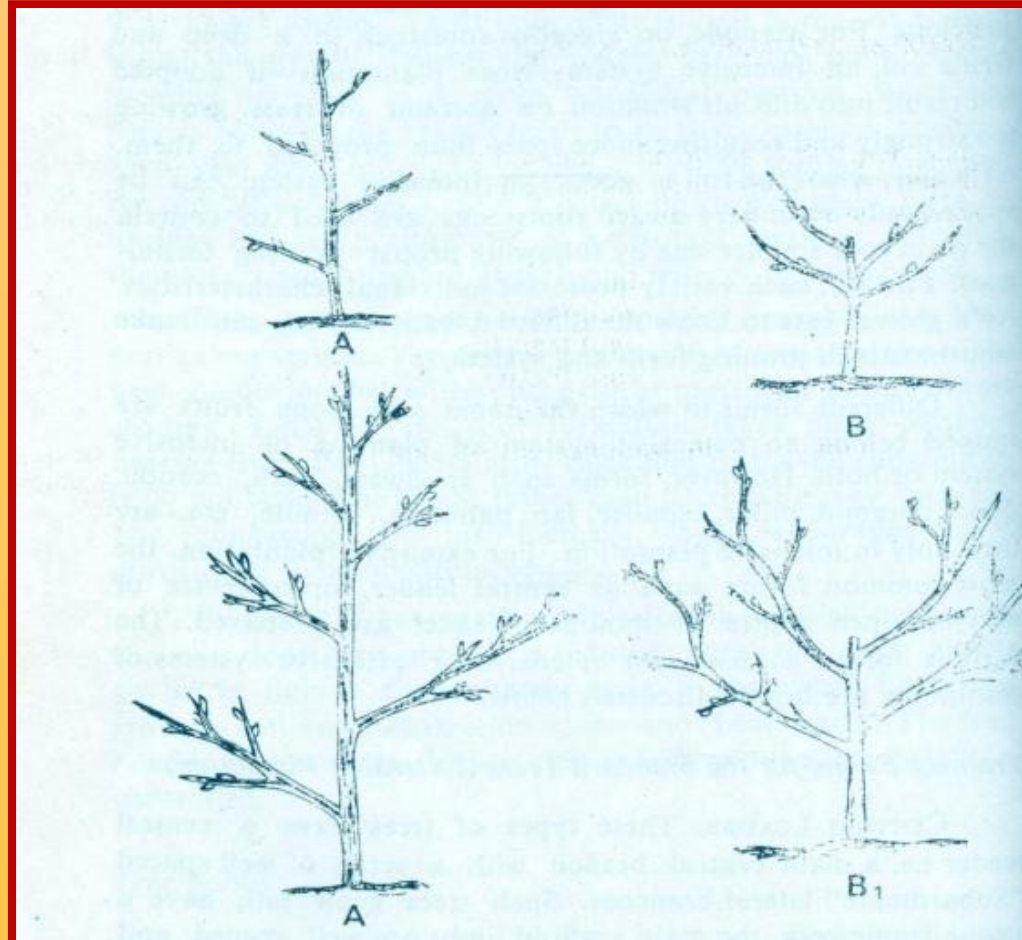


**A. Use Braces to support split branches and wood blocks to increase crotches while making the tree frame in subtropical fruits**

## B. Regulate the number and location of main scaffold limbs for better canopy

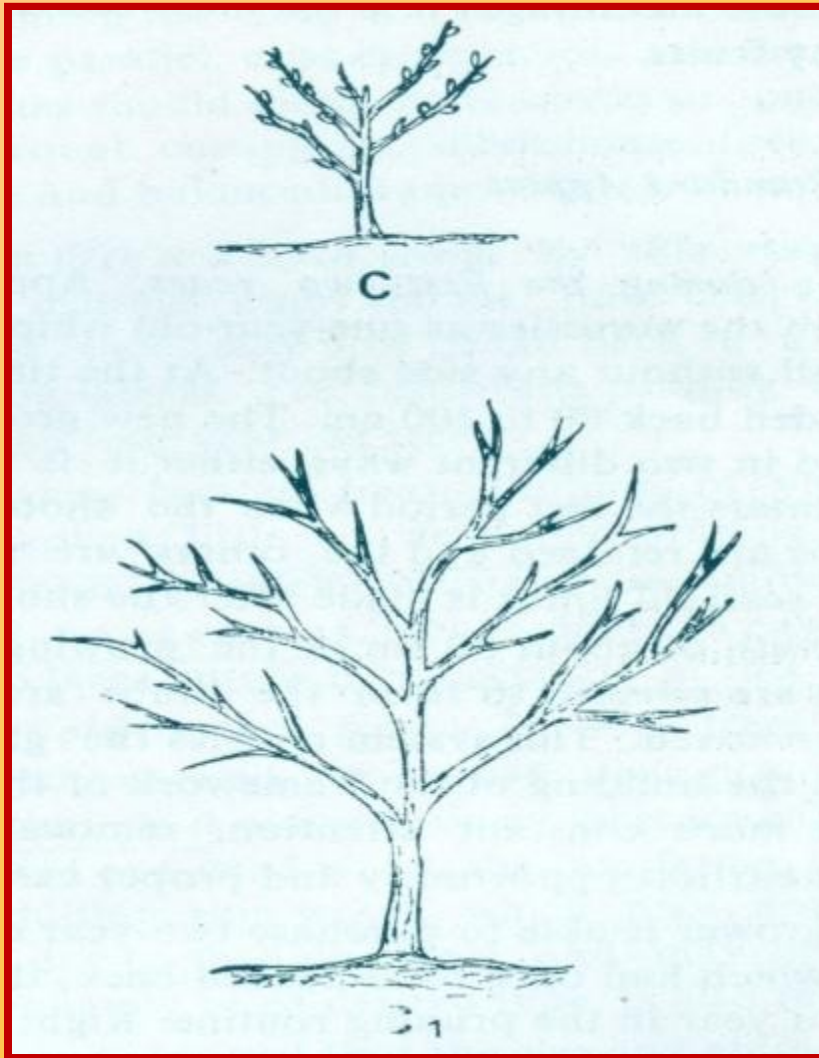


# Schematic diagram of training system in fruits



**A. Central leader    B. Open centre**

# Schematic diagram of training system.....



**C. Modified centre**



## 4. Centre opening of grown up trees

**To have sterio fruiting through Centre opening in evergreen fruit plants**

**Considerations,**

- **Long unfruitful branches due to overcrowding of centre**
- **Heavy incidence of pest and disease**
- **More economical fruit yield from 2/3<sup>rd</sup> lower canopy**

**Method**

- **Removal of upright branches from centre of tree**

**Impact**

- **Emergence of higher number of healthy shoots inside the canopy**
- **More panicle and fruit set inside the canopy**



## 5. Pruning of shoots and fruits

**Pruning is judicious removal of plant parts to maintain optimum balance between vegetative and reproductive growth for enhanced productivity and fruit quality.**



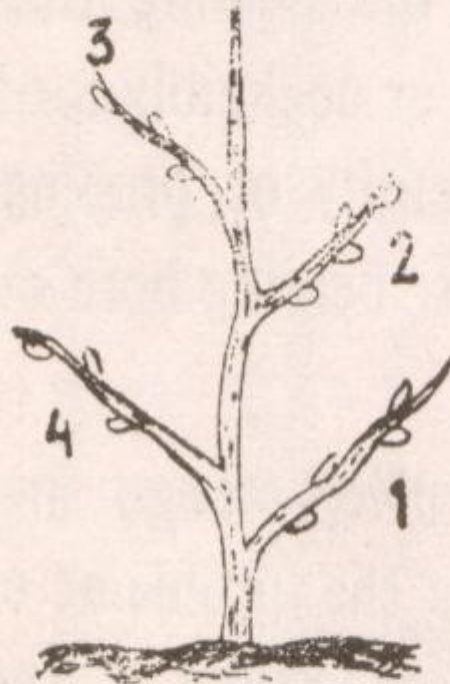


# Considerations for pruning

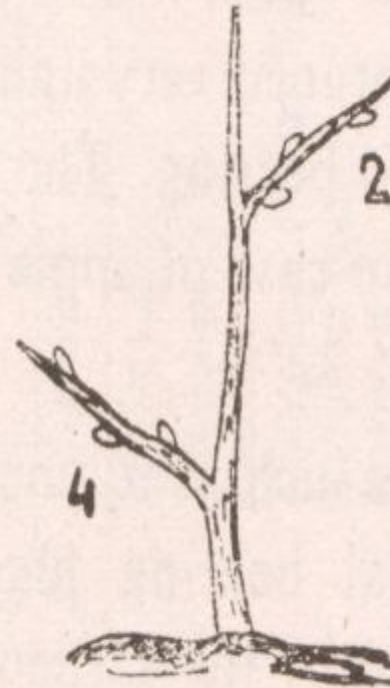


- **Purpose**
- **Time**
- **Severity**
- **Methods**

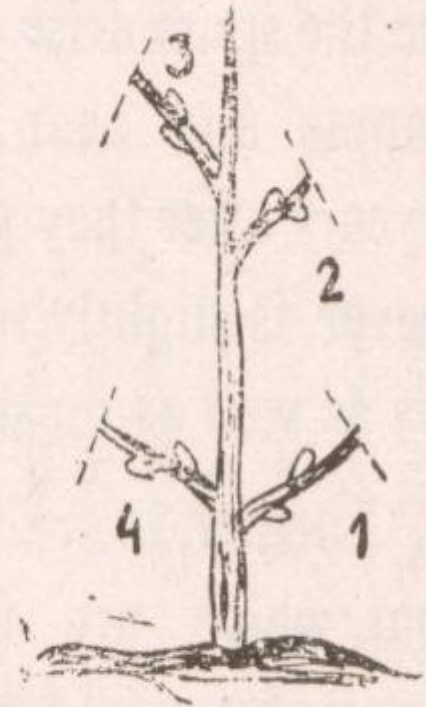
# Types of pruning



A



B



C

1. Thinning out
2. Heading back



# Pruning: An important tool in temperate fruit production



- Restrain the exuberant vegetative growth of temperate crop trees to manageable sizes and forms thereby to achieve optimum production.
- Regain overgrown, older orchard
- Stimulate flowering of new plantings
- Increase productivity of orchard
- Increase air circulation in the orchard, which lowers losses associated with diseases.

# Pruning in apple tree





# High Density planting in apple

High density planting (HDP) means to increase the plant population per unit area for increasing the production of fruit crops.

- Semi-intensive system with 500-1,000 trees/ha,
- Intensive system accommodating 1,000 to 10,000 trees/ha
- Super-intensive system accommodating 10,000 to 1,00,000 per ha.





# Components of HDP

- Use of dwarf scion varieties;
- Adopting dwarfing rootstocks and inter-stocks;
- Efficient training and pruning,
- Use of plant growth regulating chemicals; and
- Suitable crop management practices.

## Advantages of HDP

- Best Utilization of land and resources;
- Quality production of fruit crops;
- Increase in yield per unit area,
- Easy for inter-cultural, plant protection and harvesting
- Obtain export quality of the harvest.





# HDP in Apple

**There are 4 categories of HDP in apple**

- **Low (less than 250 plants/ha),**
- **Moderate (250 to 500 plants/ha),**
- **High (500 to 1,250 plants/ha) and**
- **Ultra-high (more than 1,250 plants/ha) density.** -  
**Super high-density plantings or meadow orcharding (20,000 to 70,000 plants/ha)**

**Commonly used dwarfing/semi-dwarfing rootstocks for HDP:  
M9, M26, M4, M7 and MM106**

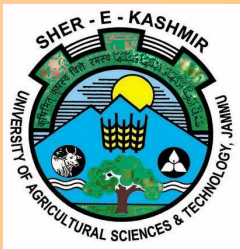
**Meadow orchards: M27**

**Spur types: MM106 and MM109 for and M7 and**

**Non-spur types: MM111**

**For J&K: MM106**



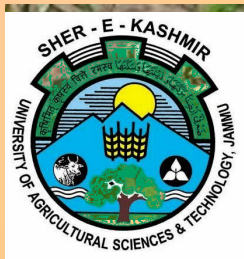


# Promising spur varieties

**Starkrimson, Red Spur, Gold Spur, Well Spur, Oregon Spur, Silver Spur, Red Chief, Bright 'N' Early, Royal Gala and Red Fuji**

## Training systems

- **Spindle bush,**
- **Dwarf pyramid,**
- **Espalier,**
- **Cordon,**
- **Palmette and**
- **Noored Holland Spindle bush**



## Peach

- Bears fruit on one-year-old shoots, which require regular annual pruning to make them suitable for high-density orcharding.
- High density in peach has been tried with planting varying from 930 to 2,050 trees per hectare yielding 13 to 34 t/ha.
- Training systems used *viz.*, Hedge row, Y-shape trellis, spindle, modified free spindle and modified leader.



## Pear

- In pear systems hedge row system gives a plant density of 888 plants/ha and causes significant increase in yields.



# Canopy Architecture Management in Apple at CITH



# Creation and utilization of space in orchard crop through tree architecture management





# Tree architecture of Apple Orchard at CITH, Srinagar



# Frontier considerations of canopy management

- **Conservation of stored food**
- **Maintaining root : shoot : fruit by pinching rather pruning.**
- **Pruning time and severity.**
- **Provision of more light and air inside the canopy for stereo fruiting.**
- **Single canopy with multiple root system concept.**
- **Boosting up of economical canopy formation.**
- **Exploring the possibilities of mechanization in pruning**





# Conclusion

**Canopy management is therefore, an essential tree management operation starts from the first year of plant establishment and enables the plant to produce/yield high quality and quantity by providing proper framework and more fruiting / yielding area.**





THANK YOU