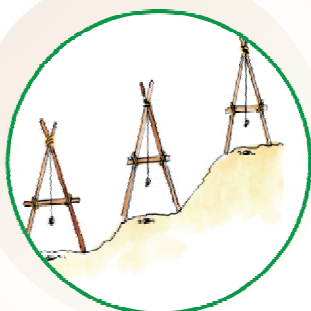
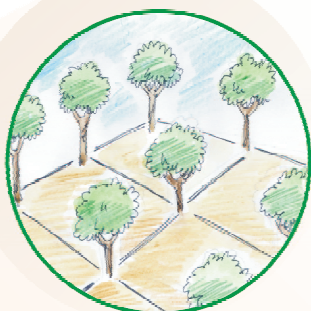


INTEGRATED ORCHARD MANAGEMENT GUIDE



# Handbook

## *Orchard Establishment & Planting*



March 2008



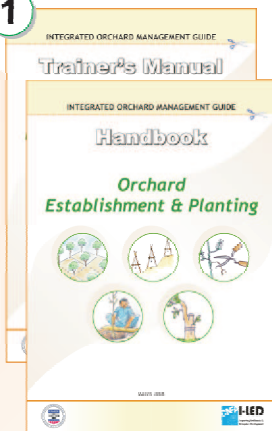
**USAID**  
FROM THE AMERICAN PEOPLE



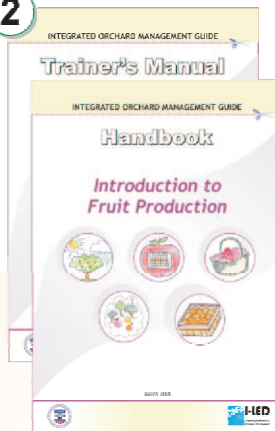
# INTEGRATED ORCHARD MANAGEMENT GUIDE



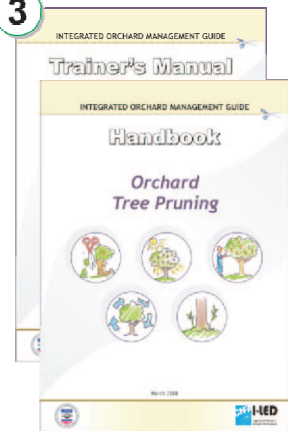
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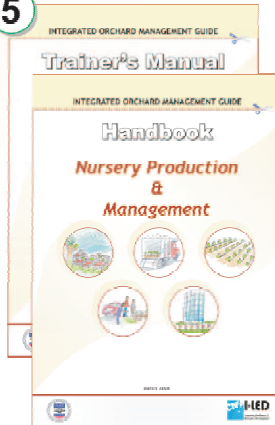
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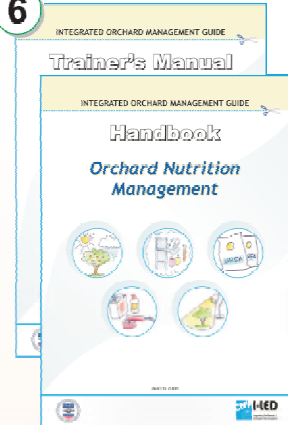
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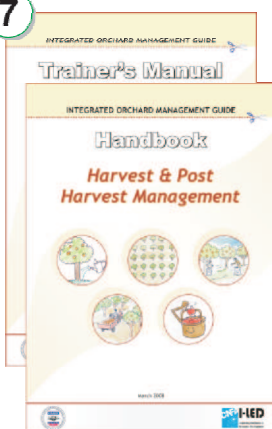
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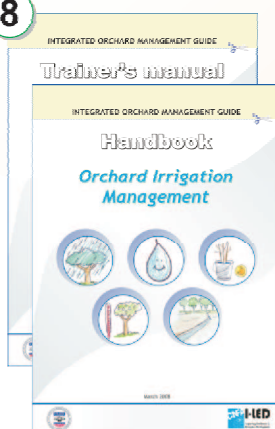
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7



8



9



ECI (Pvt.) Ltd.

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## Acknowledgment

Improving Livelihood & Enterprise Development (I-LED), a USAID funded program was designed for the affected communities of the Mansehra and Bagh districts. I-LED programs focus on building back better based on the existing businesses of the community (before earthquake) such as agriculture, livestock and poultry. Interventions were made to help these businesses build on their inherent strengths and to provide opportunities to enhance income generation, local employment, and increased economic activities.

The support provided to the community was through Matching Grants (Financial Assistance) linked with the delivery of technical trainings and skill enhancement relevant to their businesses.

To address the deficiency of existing knowledge, a series of training manuals was created to support nursery and orchard growers. The following topics were included in this series of modules:

- |                                     |                                  |
|-------------------------------------|----------------------------------|
| 1. Introduction to Fruit Production | 2. Orchard Establishment         |
| 3. Orchard Tree Pruning             | 4. Orchard Irrigation Management |
| 5. Harvest/Post Harvest Management  | 6. Orchard Nutrient Management   |
| 7. Small Farm Business              | 8. Integrated Pest Management    |
| 9. Nursery Management               |                                  |

This interactive training series was designed for both trainers and potential business owners (potential partners). Pilot training were also conducted at village level with real farmers groups to test these modules. These modules were also evaluated by a diverse group of training providers and technical expert's to provide as appropriate a training resource as possible.

The communities, farmers and technical expert from agri industries appreciated the I-LED effort for the development of these modules and found the material to be an excellent contribution towards farmers' livelihood initiatives.

We acknowledge and appreciate Dr. John Bellow's dedicated technical input for the development of these modules, Empowerment thru Creative Integration (ECI)'s contribution in developing this complex subject into to participants handbook and instructional guide for trainers, easy and absorbable methodologies; and suitable visualization for non-literate farmers.

We also appreciate the support, inputs and suggestions of CNFA training department, agriculture and horticulture experts and local organizations (Hazara Agriculture Research Station, Bafa Agriculture Research Station, Cabi South Asia, CITRUS "Committed for improvement transformation& resource up-gradation of the social sector and Agriculture expert of CNFA I-LED) who provided continue support in providing technical inputs and suggestions to make this material more beneficial to the rural communities.

Various references from a variety of sources were used to develop and validate the contents. Its is not possible to individually acknowledge each source .However we hope this series of modules will not only help the farmers of rural areas but all relevant institutions, organization and trainers will also be benefited with the provided information. We are deeply grateful to very one who has gifted even a small input to make these materials unique and useful for the target groups.

These modules are CNFA I-LED's contribution towards knowledge transfer within the horticulture sector .We would therefore like all users to feel free to copy, distribute, display modules and benefit the sectors and more specifically the farmers. Electronic copies may be found at <http://www.cnfapakistan.org>

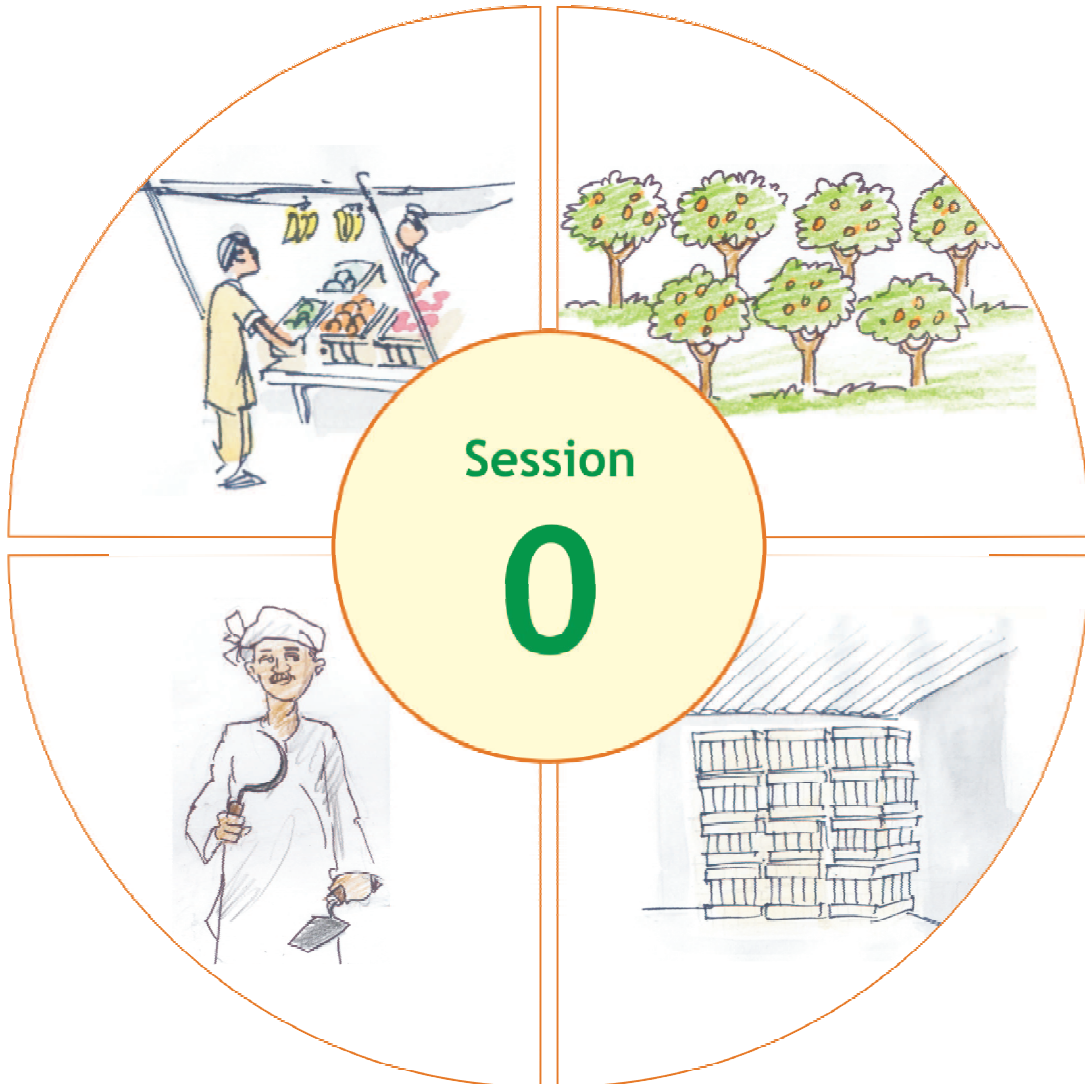
CNFA I-LED

## Orchard Establishment and Planting

*This Handbook is for potential orchard growers. It covers important topics with regard to 'Establishing an Orchard', e.g. selecting orchard sites, trees to be planted, planting designs and spacing, and orchard management practices.*

*It is expected that after participating in a training on Orchard Establishment and Planting, participants should be able to develop individual strategies for establishing their own orchards.*

# Introduction



## Learning Objectives



By the end of this 2-day Training, participants will be able to:

List the factors that affect success or failure of an orchard site (even before planting).

Describe rootstocks, and how its effective selection will affect growth and size of trees.

Appreciate the role of tree density in increasing fruit yields.

Describe the characteristics commonly linked with a specific fruit variety.

List different factors that must be considered when laying out an orchard. Demonstrate how to lay out an orchard on level or sloping land.

Demonstrate the methods and best practices for planting a bare root tree in a new orchard.

Describe and rationalize the proper pre-planting and post-planting care of bareroot and container trees.

List the potential advantages and pitfalls of intercropping high value annual crops, and identifying several suitable crops.


Describe ways to avoid post-plant damage to fruit trees and the likely impacts of failing to prevent animal damage.  
List strategies to manage the orchard understorey.





## Why focus on Orchards?

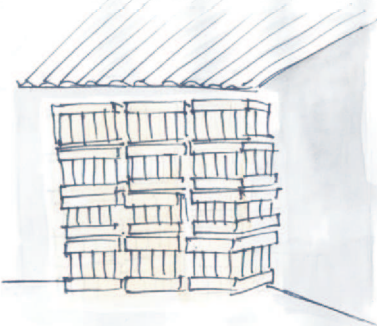
**1**



Tropical, sub-tropical and temperate climate allows for a variety of fruits.

An illustration of a fruit stall with various fruits like mangoes, apples, and oranges displayed on a table. A person is standing behind the counter, and another person is looking at the produce.


**2**



Increased demand both nationally and internationally therefore high returns possible.

An illustration of several wooden crates stacked on top of each other, representing storage or transport of produce.


**3**



Decades of experience and available skills and manpower.

An illustration of a man wearing a white turban and a white kurta, holding a large circular object, possibly a piece of wood or a tool, and a small square object.


**4**



Fruits have micronutrients and vitamins that keep people healthy (an apple a day keeps the doctor away).

An illustration of two glass jars filled with fruit. One jar contains an orange and the other contains an apple.


**5**



Orchard owners enjoy 'reputation' and social status.

An illustration of two men in traditional attire standing next to a table. One man is pointing towards the table, which has some items on it.

**6**



Orchards can extend into additional income, e.g. promotion of tourism, horticulture therapy.

An illustration of two men in traditional attire standing in an orchard with several trees bearing fruit.

# What is ..... ?



## Horticulture

....a Greek term that is derived from

**Hort** (garden) and **Culture** (to cultivate).



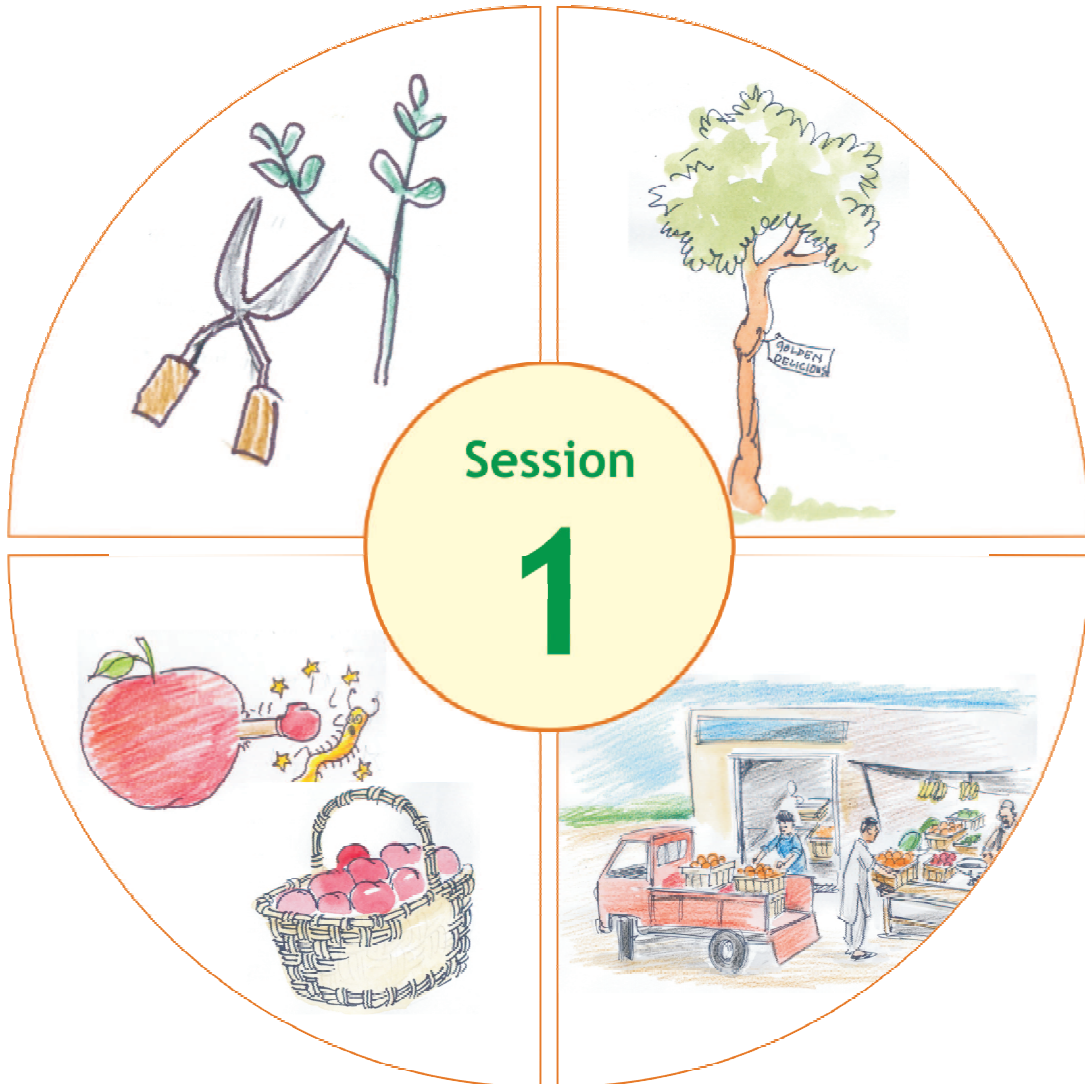
## Orchard

....is an area of land where fruit trees are grown.





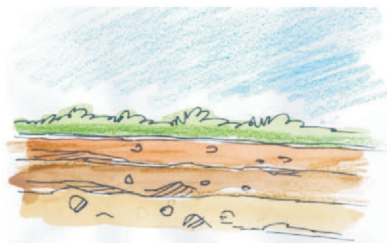
# Site & Plant Selection!



## Where to Plant? Considerations for Choice of Orchard Site

1

### Soils and Fertility



The more fertile the soil, the greater the quantity and quality of fruit!

2

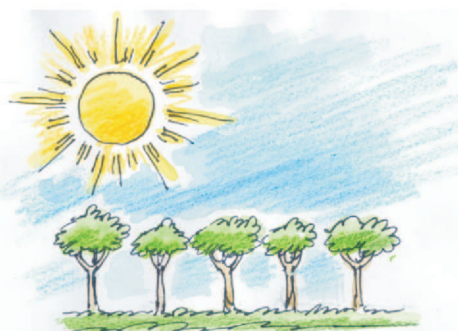
### Availability of Irrigation Water and Precipitation



There should be good source and supply of irrigation water, and particular knowledge of rain fall distribution

3

### Solar Aspect



Light affects the food preparation in leaves and development of fruit color

4

### Temperatures and Air Flow & Wind Direction



Day/night variation in temperature and wind velocity affect quantity & quality of fruit grown

5

### Access to Markets



Access to Markets can affect both the inputs (fertilizers, services) and sale of products



## What to Plant, and How Many? Considerations for Choice of Orchard Site



## What to Plant, and How Many? When Deciding on Fruit Trees, Think About....

1

Hardiness and growth potential

2

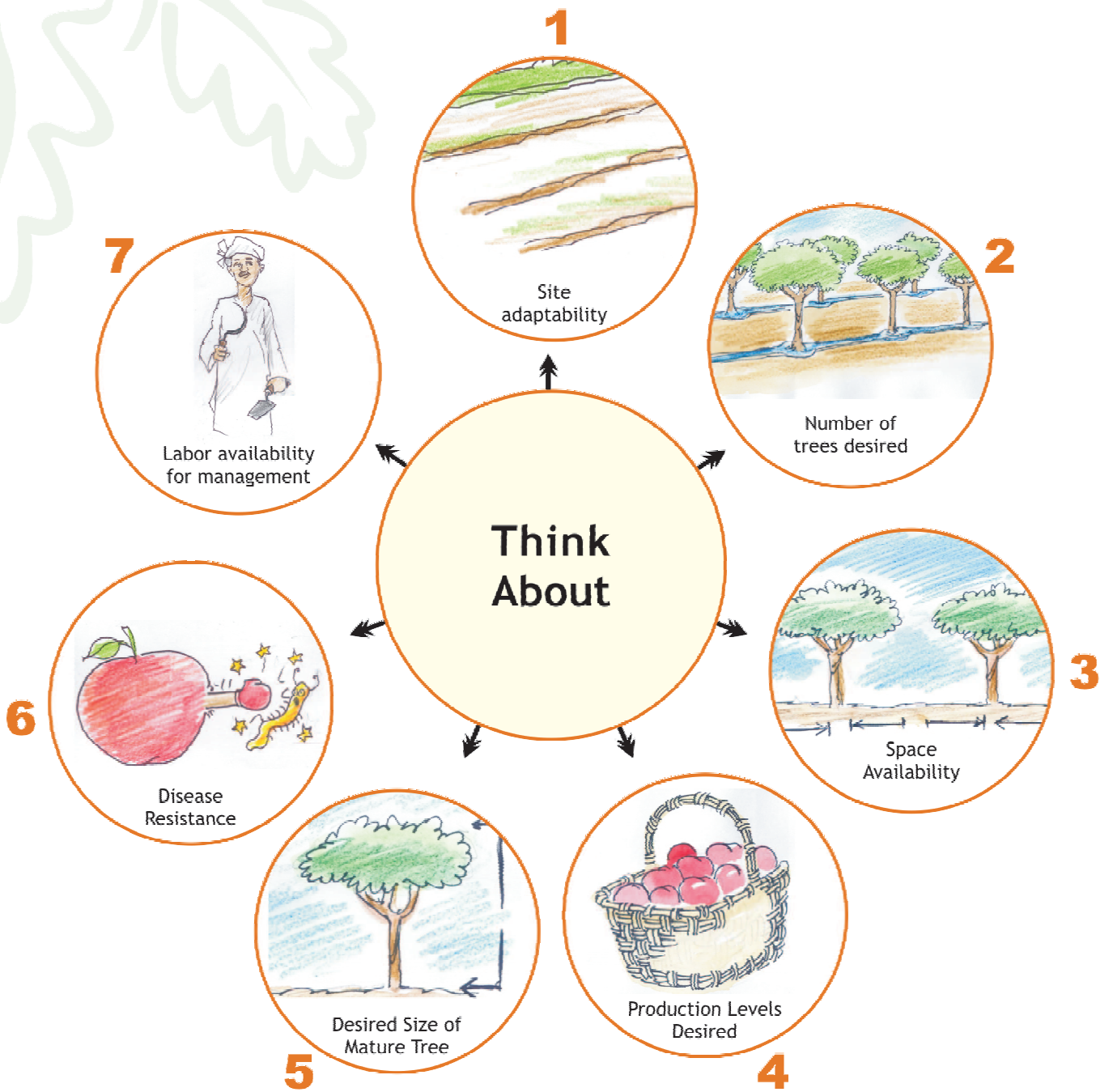
Scion variety  
x  
rootstock interactions

3

- Types of rootstocks
- Standards
  - Semi-dwarf
  - Dwarf

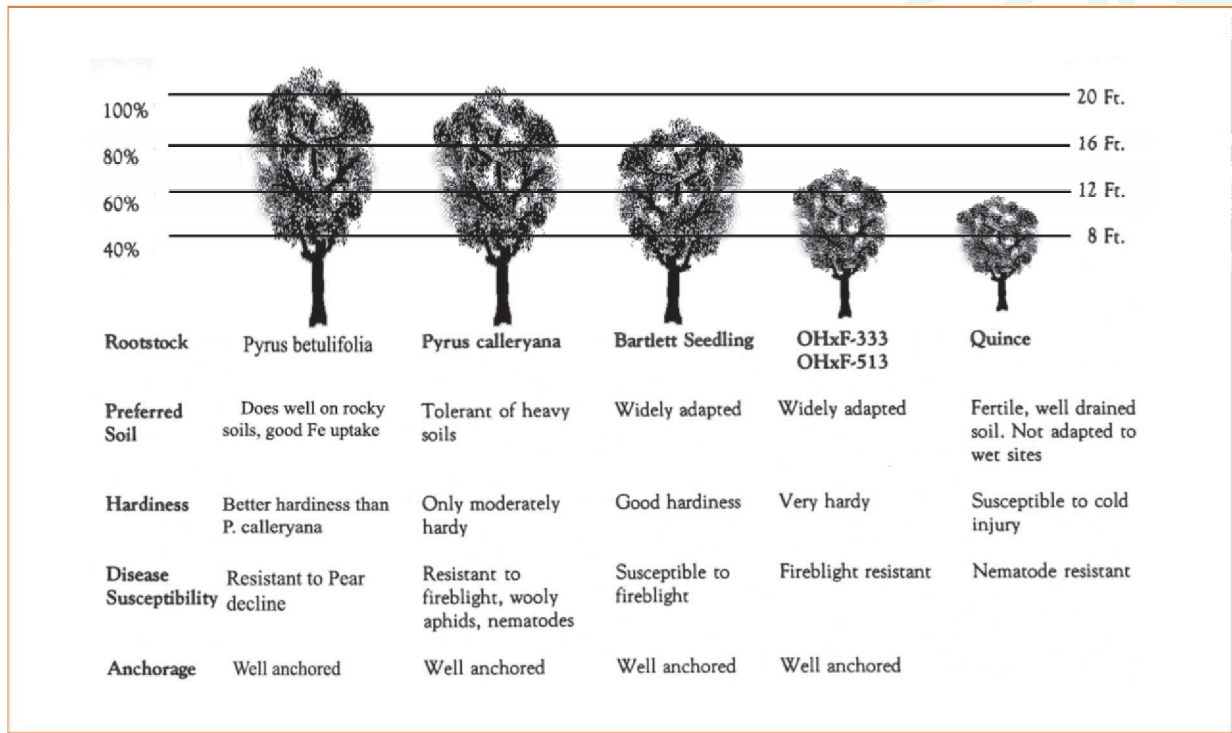


# How do Rootstocks Affect Orchard Operation?

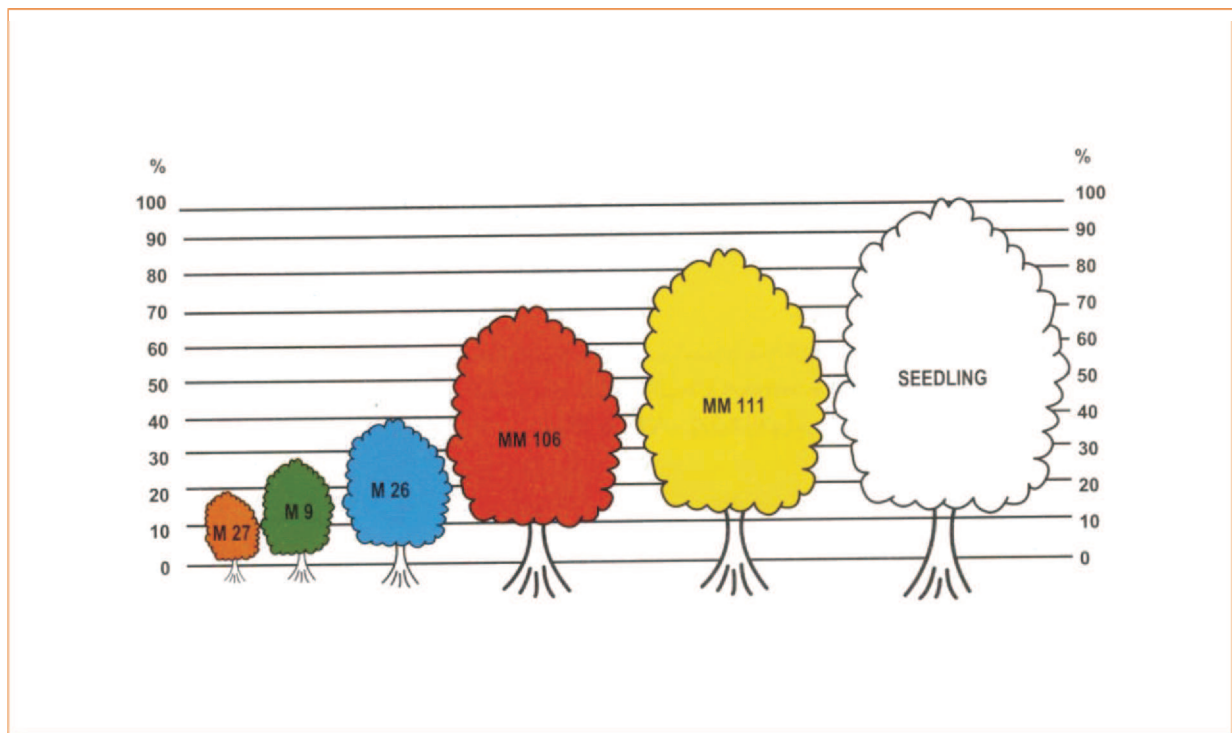




## Clonal Rootstock Advantage



Apple



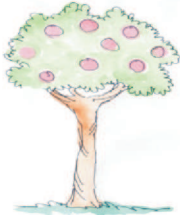
Pear






### Size of Rootstock

**Dwarf**



20 kg/tree/5th yr  
80 kg/tree/9th yr

**Semi-Dwarf**



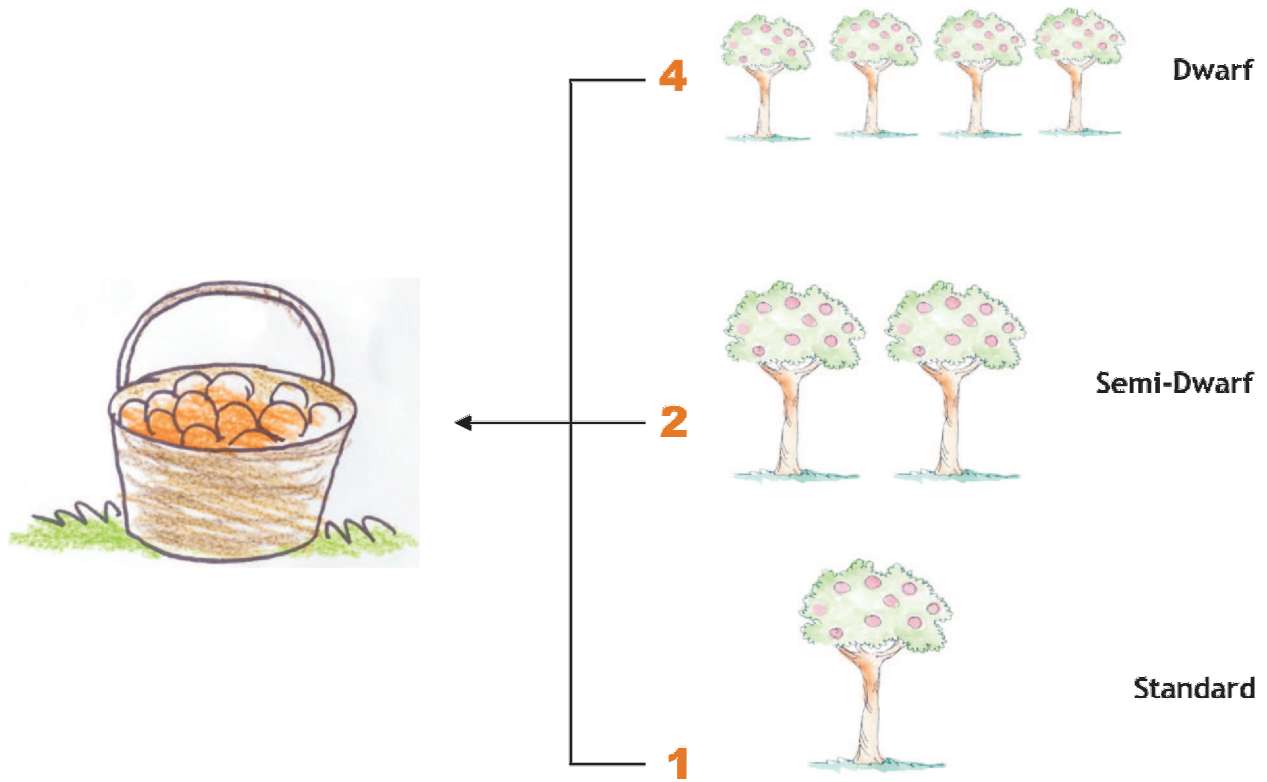
40 kg/tree/5th yr  
160 kg/tree/9th yr

**Standard**



80 kg/tree/5th yr  
320 kg/tree/9th yr

### Yield from

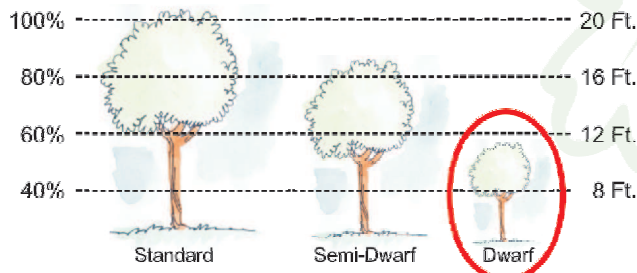


Dwarf trees tolerate higher densities

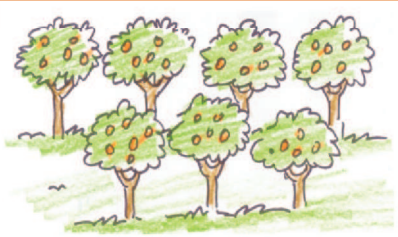







## Rootstock



### Advantages & Disadvantages of Sizes



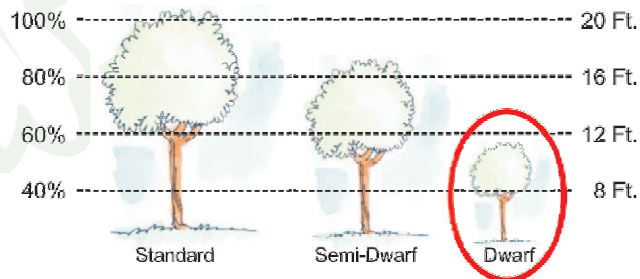
### Advantages

- 1  Takes up less space each
- 2  First fruit in 3-4 years
- 3  Easier to reach all parts of the tree
- 4  Often produces larger fruit
- 5  Needs less spray per tree and is easier to spray
- 6  Easier to prune and train
- 7  Easier to harvest
- 8  Better colored fruit



## Rootstock

### Advantages & Disadvantages of Sizes



### Disadvantages

1



Fewer fruit per tree

2



More expensive

3



Require stakes or trellis support

4



Poor yield without excellent management

5



Much shorter life span....  
(usually only 12 to 15 years)

6



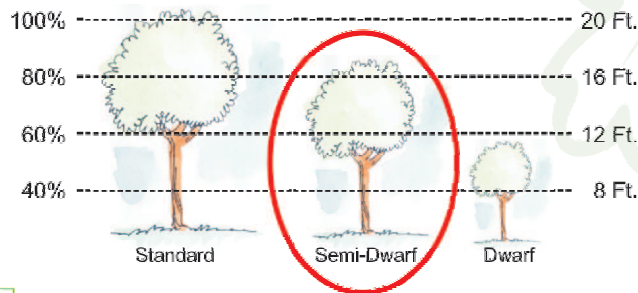
Trees damaged easier

## Rootstock



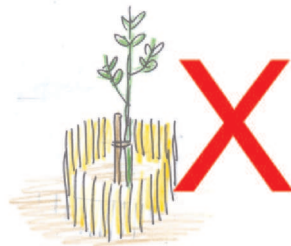
11

### Advantages & Disadvantages of Sizes



### Advantages

1



May not need as much support as Dwarf.

2



Will bear first fruit when 4-5 years old.

3



Easier to care for than standard sized tree.

4



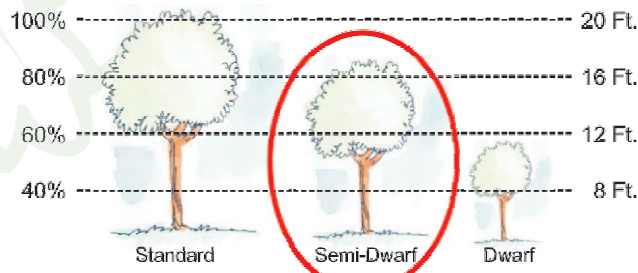
Produces more fruit per tree than dwarf.

**Trees planted using semi-dwarf rootstocks will reach a height of 15 to 20 feet**



## Rootstock

### Advantages & Disadvantages of Sizes



### Disadvantages

1



May need some support as compared to standard.

2



May take up too much space.

3



Many semi-dwarf rootstocks have pest and disease problems.

4

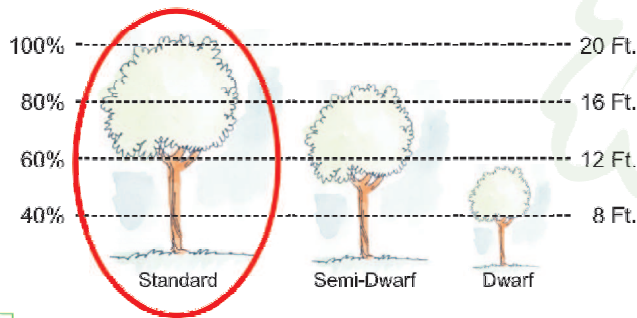


Harder to manage and care for than dwarf.

## Rootstock



### Advantages & Disadvantages of Sizes



### Advantages

1



Produces a large number of apples per tree.

2



Does not need any support.

3



Less expensive to purchase.

4



Most tolerant of poor management.

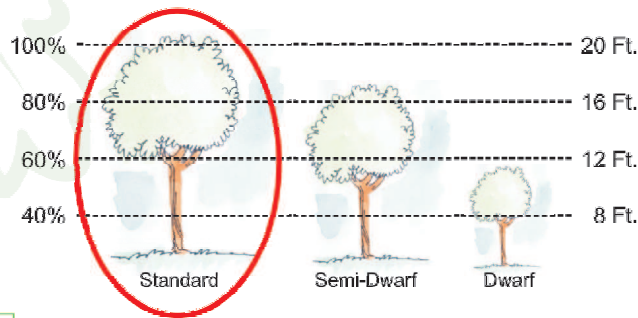
5



Has a long life span.

## Rootstock

### Advantages & Disadvantages of Sizes



### Disadvantages

**1**

Hard to manage.

**2**

Takes up a lot of space.

**3**

Hard to spray effectively.

**4**

Hard to prune and train.

**5**

Does not begin fruiting for 5-6 years.

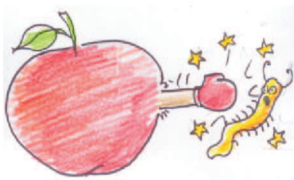
**Apple trees planted on standard rootstocks will produce large, full-sized trees that may grow more than 25 feet tall.**

# Scion Variety Selection




## Considerations for Selection of Varieties (Cultivars)

**1**




Disease resistance to regional problems.

**2**



Maturity dates.

**3**



Waxiness, ripening, brix, bruising.

**4**



Past experience or personal favorite.

Production


Marketing

**1**



Storage qualities.

**2**




Intended market or use of fruit.

**3**



Suitability for shipping.

**4**

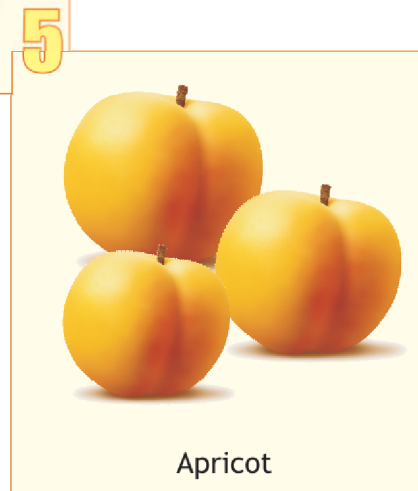
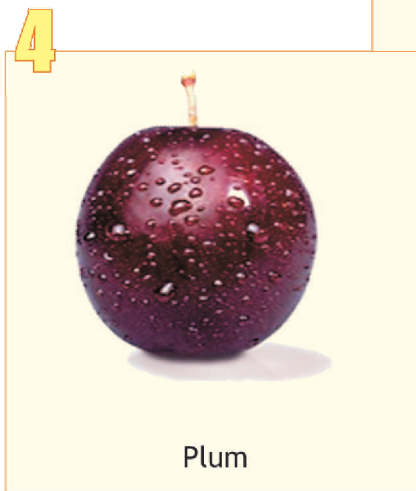
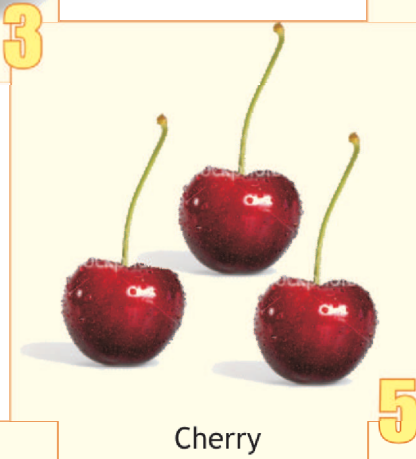
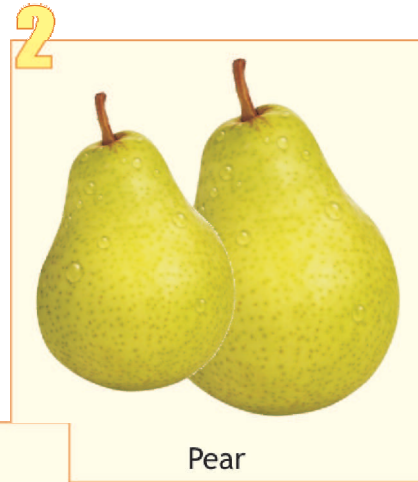
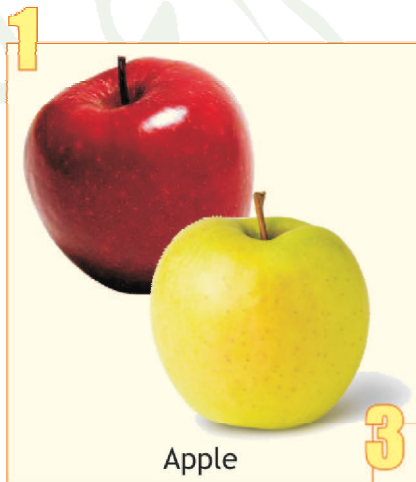


Buyers Preference.



## Selection of Cultivars

Cultivars or variety determine color, size, shape, taste weight resistance to disease and determine when they will ripe.



### Do you know....?

There are over 250 different know strains of Red Delicious

Over 200 European pears, and 30 Asian pears

There are over 6,000 know cultivars of apples

## Apple Selection

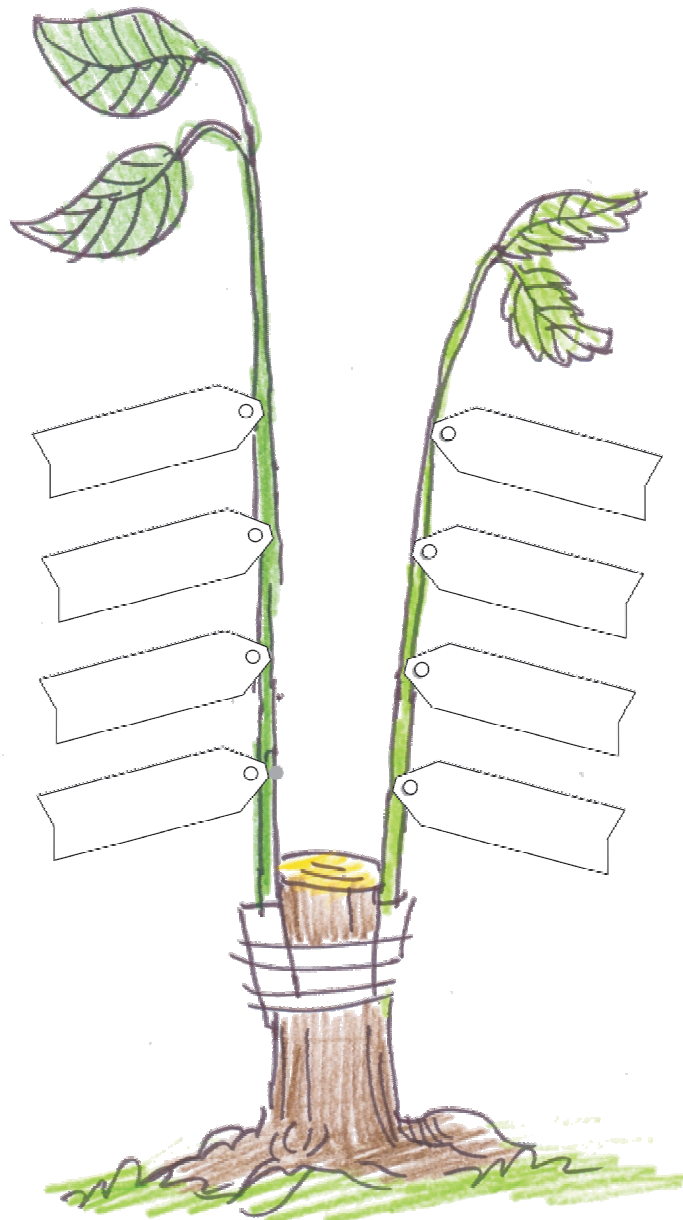


Apples are one of the oldest deciduous fruit crops



### Disease Resistant Apple Cultivars

- Dayton
- Enterprise
- Freedom
- GoldRush
- Jonafree



- Liberty
- Priscilla
- Pristine
- Redfree





## Pear Selection

Pears can be divided between European and Asian pears

Asian



Asian pears are most commonly rounder

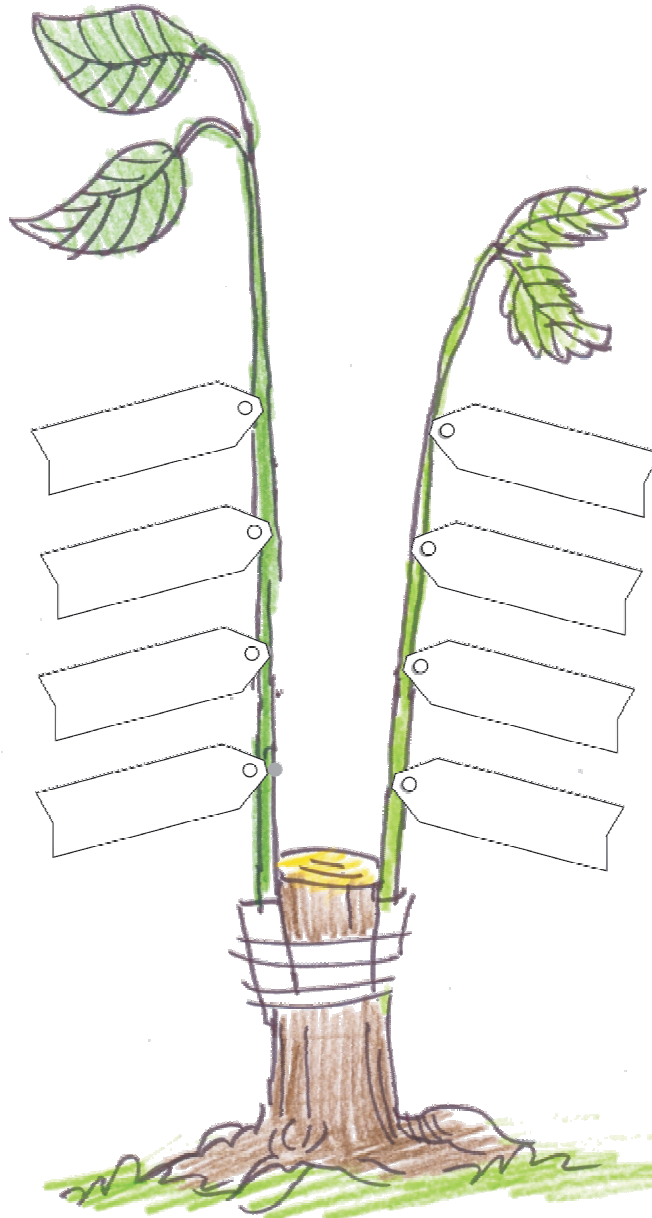


European

European pears are mainly pyriform in shape

There are some rootstock incompatibility issues and Asian pears require a vigorous rootstock to make up for their low vigor

- Shinko
- Ya Li
- Chojuro



- Ayres
- Magness
- Potomac

## Cherry Selection

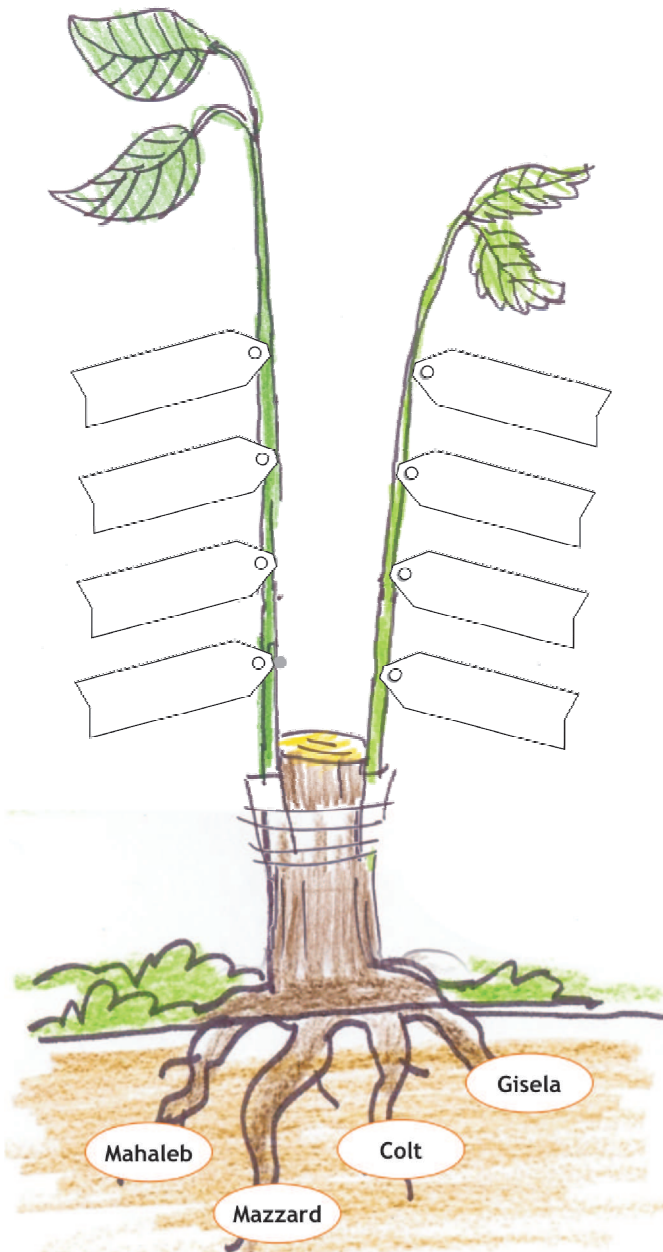


Cherries are either sweet or tart varieties  
Colors range from Yellow to nearly black  
Management strategies to maintain production  
and ease of management are critical



### More Resistant Cherry Cultivars

Regina  
Star Dust



Sweetheart  
Utah Giant



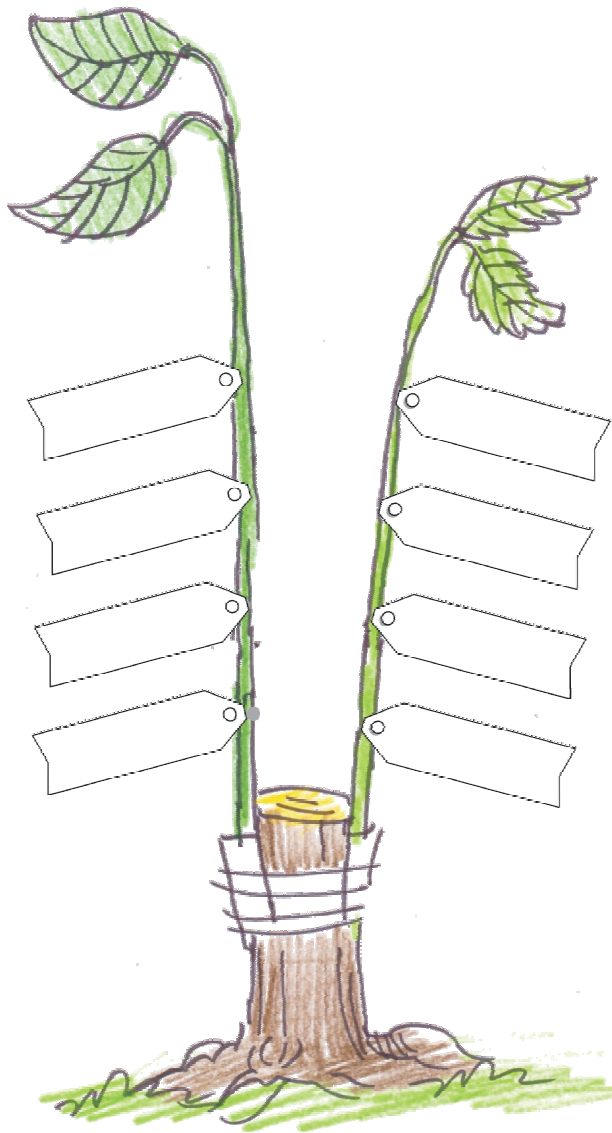
## Plum Selection

- Plums are either European or Asian  
European plums usually more suited to drying
- Most commonly produced on seedling peach or other plum rootstocks such as myrobalum
- Management of viruses and diseases are primary concern in plum production
- Pollination needs are also critical



### Quality Plum Cultivars

- Methley
- Beauty
- Shiro
- Satsuma
- Burbank



- AU Amber
- AU Rosa
- AU Rubrum
- AU Cherry
- AU Roadside
- Italian Prune

## Pollination Chart for Plum

As compared to other fruits, plums pollination require careful attention as given in the chart



Pollinated tree	Pollen Source	Alycha	Beauty	Blue Damson	Brooks	Burbank	Damson	French	Green Gage	Hollywoo d	Epinense	Italian	Methley	Mt. Royal	Peach Plum	President	Santa Rosa	Satsuma	Seneca	Shiro	Spring Satin	Stanley	Superior	Toka	Yellow Egg
Alycha		■																							
Beauty			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Blue Damson				■						■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Brooks					■					■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Burbank				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Damson							■																		
French								■		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Green Gage									■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Hollywood										■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Imperial Epinense										■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Italian											■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Methley											■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Mt. Royal														■	■	■	■	■	■	■	■	■	■	■	■
Peach Plum															■	■	■	■	■	■	■	■	■	■	■
President																■	■	■	■	■	■	■	■	■	■
Santa Rosa																	■	■	■	■	■	■	■	■	■
Satsuma																		■	■	■	■	■	■	■	■
Seneca																			■	■	■	■	■	■	■
Shiro																				■	■	■	■	■	■
Spring Satin																					■	■	■	■	■
Stanley																						■	■	■	■
Superior																							■	■	■
Toka																								■	■
Yellow Egg																									■

■ Shaded combination will not pollinate each other.

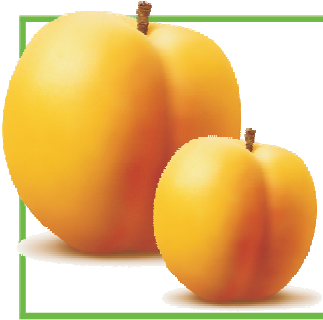
□ Unshaded combination will be good pollinators





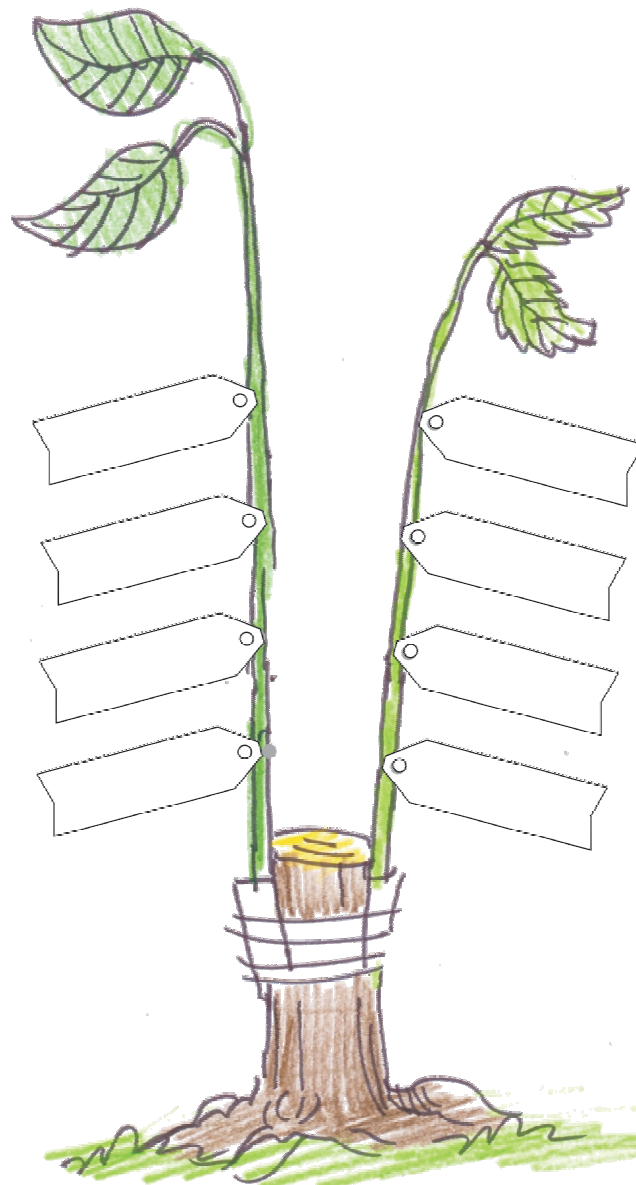
## Apricot Selection

New apricot x plum hybrid varieties  
Aprium and Pluots show superior  
quality



### Common Apricot Cultivars (Late blooming)

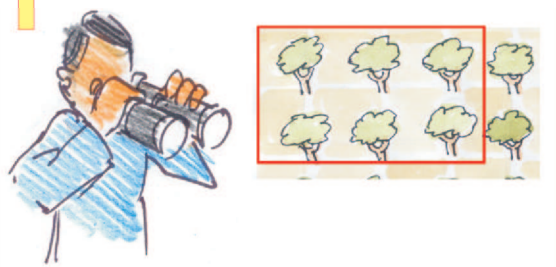
- Harglow
- SHAA-KAR  
PAREH
- Chinese  
(Morman)
- Tilton
- Tisdale
- Goldensweet
- Kabuli



- Habiju
- Khuban
- AU Rubrum
- AU Cherry
- AU Roadside
- Italian Prune

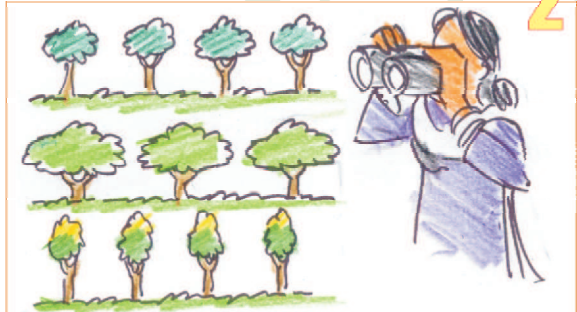
## How to Evaluate Varieties for your Orchard?

1



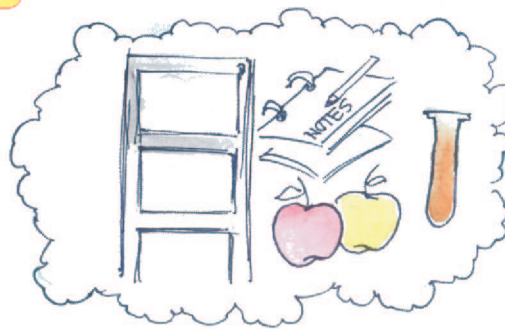
Reserve 1 to 4 rows as evaluation lines-plant trees and watch!

2



Plant one to four trees per variety for evaluation and comparison. 25 varieties are not too many to invest for evaluation purposes.

3



Review old fruit trials, records, interesting varieties, and local knowledge.

4



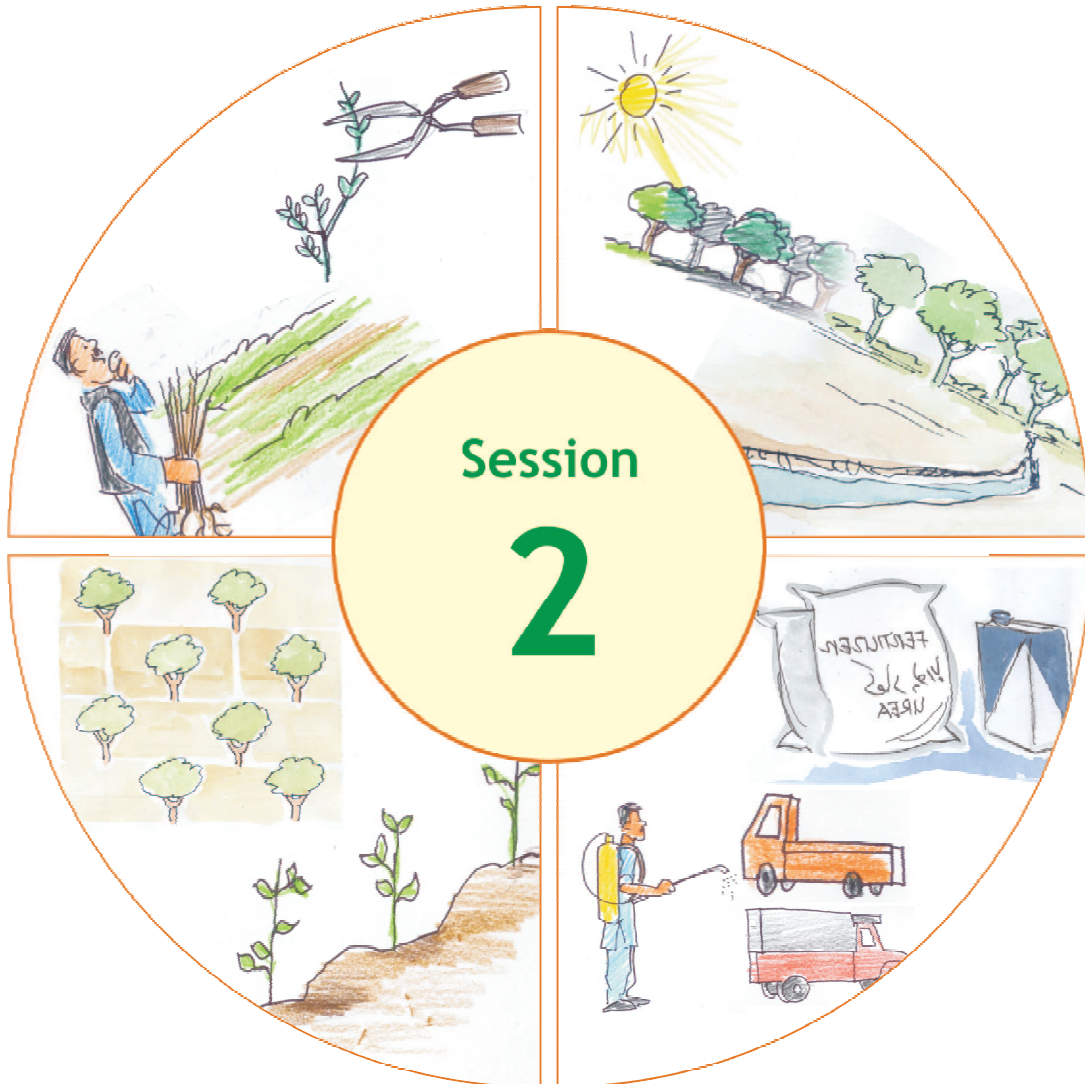
Visit someone else's orchard to make your selections based on what you see.

5



Visit the closest agriculture research station.

# Orchard Design and Layout



## Zahoor Subhani Ki Kahani



Zahoor Subhani decides to establish an Orchard. He plans to use his fertile land. He goes out and buys rootstock and scion variety.



He decides to plant a lot of trees so that even if some do not take root, he will still be left with a large number of trees.



*He dreams of a large crop, and how he will make a lot of money.*



**What Actually Happened? Why?**





## Spacing

Spacing is.....



.....the distance between plants and rows.

Spacing affects.....

1



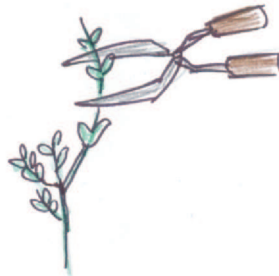
Tree size & density

2



Ultimate production  
(quantity & quality of fruit)

3



Pruning practices

4



Density, which can affect yield

5




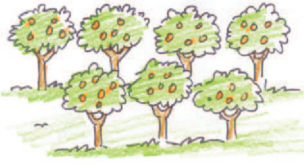


Equipment Access  
(wagons, trucks, sprayers)

## Planting Considerations?



### A) Tree spacing & orchard density

If distance between trees and rows is.....

 <p>16 x 6 = 250 trees/kanal</p>	 <p>10 x 10 = 54 trees/kanal</p>	 <p>12 x 15 = 30 trees/kanal</p>	 <p>15 x 20 = 18 trees/kanal</p>
<p><b>Most Dense</b></p>	<p><b>Dense</b></p>	<p><b>Normal</b></p>	<p><b>Least dense</b></p>


### High Density



#### Advantages

#### Disadvantages



 <p>Increase early Production</p>	 <p>Higher Returns</p>	 <p>Increase in Pests and Diseases</p>	 <p>Reduced Access of Light</p>
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## Planting

### What is Planting?

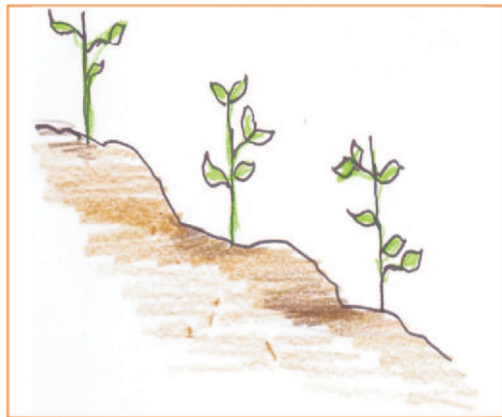
A process that begins with the preparation of the soil till plantation of a tree.

### When Planting, Consider.....

Straight Rows on Level Land



Contoured Rows on Sloping land



Row Direction




# Planting Considerations?



## B) Orchard Layout


Square



Distance between row & tree approx. same?

The diagram shows a 5x5 grid of trees. Each tree is represented by a green canopy and a brown trunk. The spacing between trees in both rows and columns is equal.

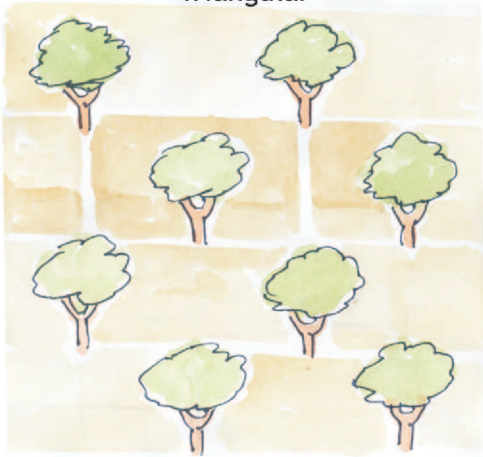
Rectangular



Distance between the tree is closer than the rows

The diagram shows a 5x8 grid of trees. The spacing between trees in each row is significantly smaller than the spacing between the rows.

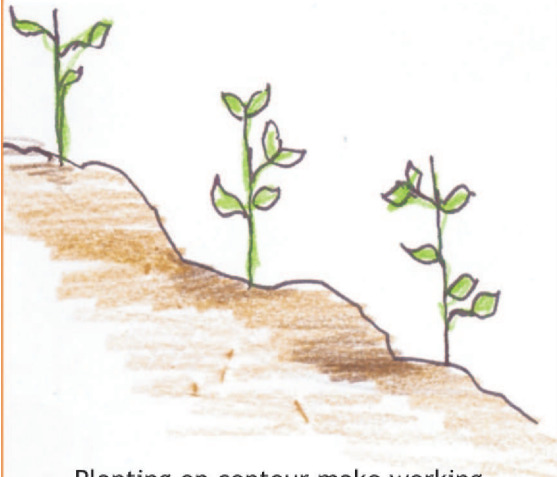
Triangular



Best use of land area as it allow the highest density planting

The diagram shows trees planted in a triangular pattern on a sloped terrain. Each tree is positioned at the vertex of a triangle, allowing for a higher density of trees compared to square or rectangular layouts.

Contours/Terrace



Planting on contour make working in the orchard easier on hilly land

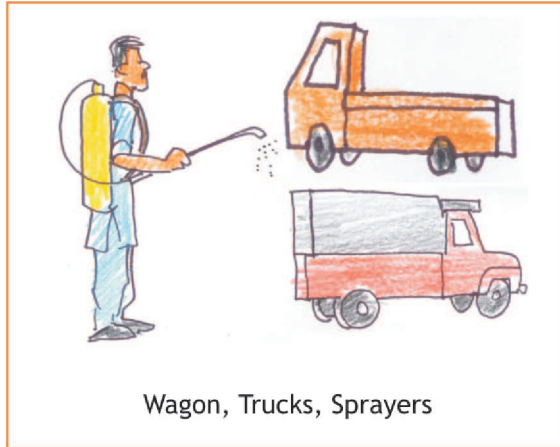
The diagram shows three trees planted on a hillside, each on a different contour line. The ground is shaded to represent the slope, and the trees are positioned to follow the natural curves of the land.





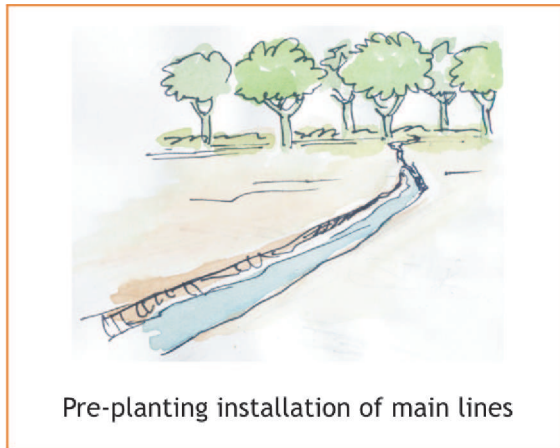
## Planting Considerations?

### C) Equipment Access



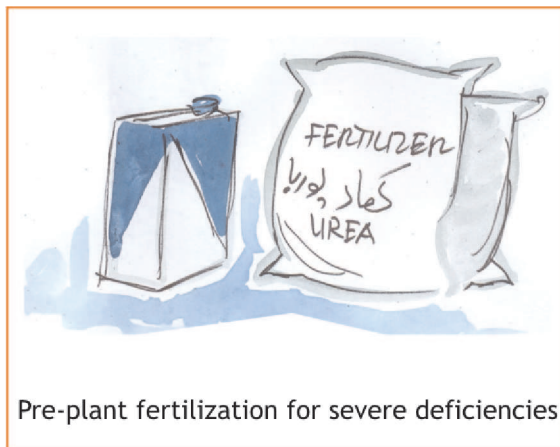
Wagon, Trucks, Sprayers

### D) Irrigation



Pre-planting installation of main lines

### E) Fertilization



Pre-plant fertilization for severe deficiencies

## Planting Considerations?



27

Initial Plant Density



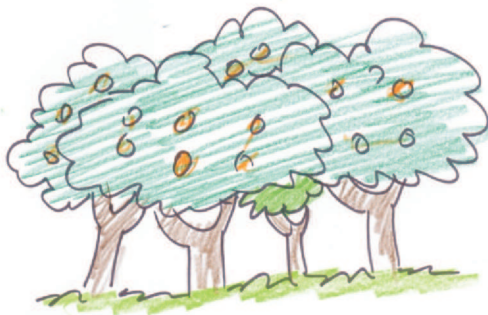
Plant at double density to be yields in the early years

Trees grows using space



With time, trees get larger

Trees are now very close together



Canopy becomes quite dense

Half the trees are removed



Growers removes trees

Thinned trees keep growing



Orchard reaches its max size

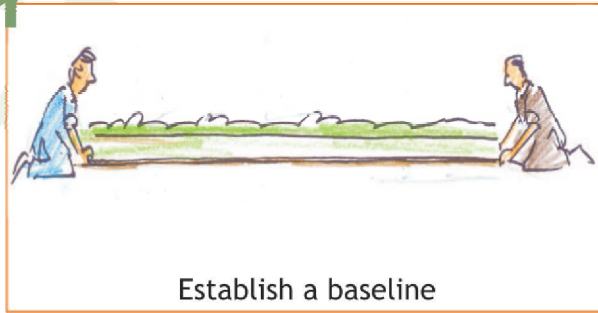




## Orchard Design and Layout

Marking out the Orchard Planting on Level Land

1



Establish a baseline



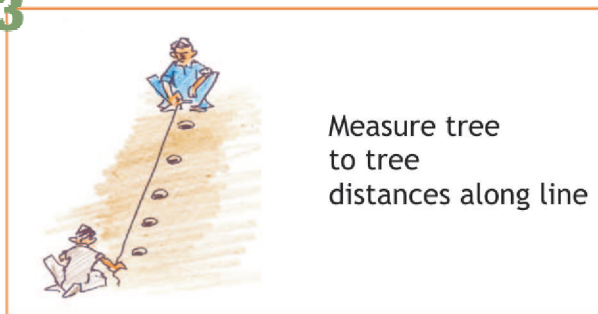
2



Establish a perpendicular



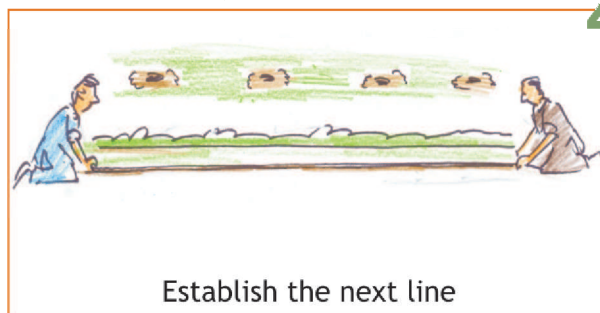
3



Measure tree to tree distances along line



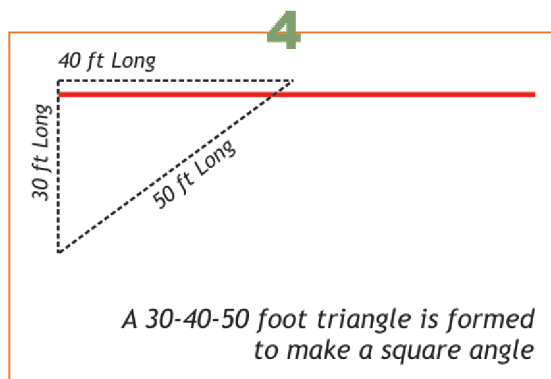
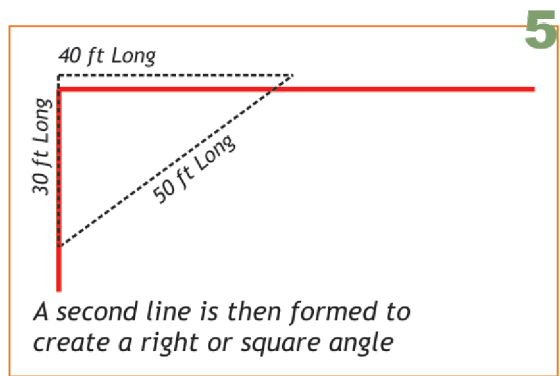
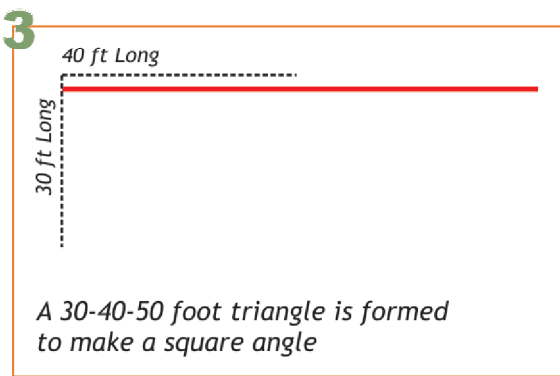
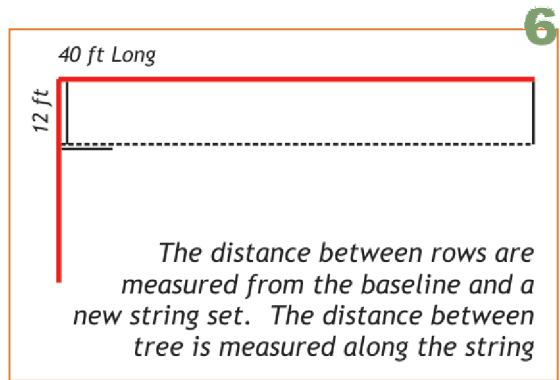
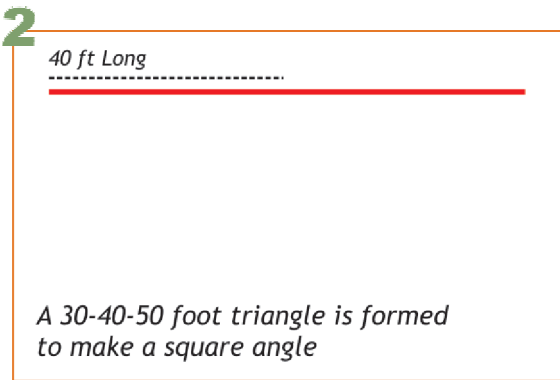
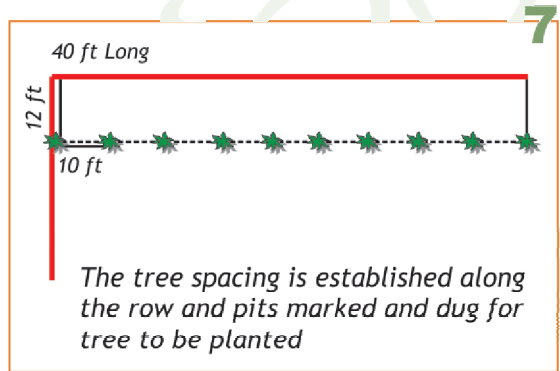
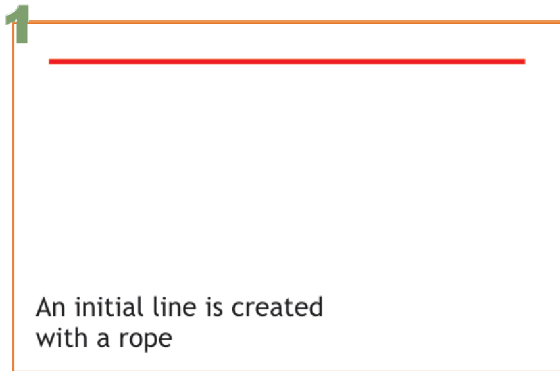
4



Establish the next line

# Orchard Design and Layout

Detailed Instruction for Layout on Level Land







## Orchard Design and Layout

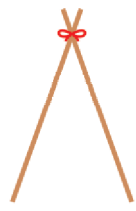
Detailed Instruction for Layout on Sloping land

### CONSTRUCTION of the 'A-frame'

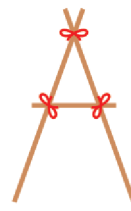
A-Frame should be constructed on the most level piece of ground available



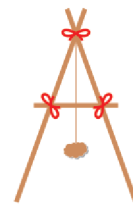
2 poles of the same length and 1 shorter pole for the crosspiece



Using nails, screws, rope, wire, or other items assemble the three poles in the shape of an A



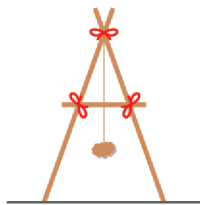
The crosspiece should be attached halfway between the end of the longer poles and the point where they cross



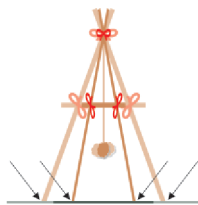
a heavy item such as a stone or piece of metal is tied to the end of a piece of stout string.

### CALIBRATION of the 'A-frame'

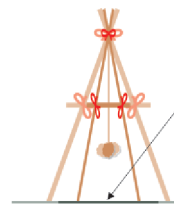
A-Frame should be Calibrated before using it.



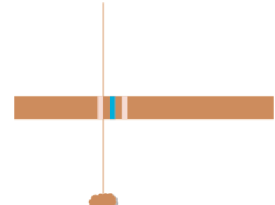
With the two legs of the a-frame resting on nearly level ground, make a mark on the crosspiece where the string passes



Next reverse the two legs so that each leg touches the ground where the other leg previously stood



The string will pass the crosspiece in a slightly different location, and this second location should be marked also



Finally make a 3<sup>rd</sup> mark in the center between the two marks (if they are not already too close). This is the level line

### USING of the 'A-frame'

- 🍎 Place one leg of the a-frame at the beginning of the contour line. Allowing the string to hang free, position the second leg on the ground so that the string passes the crosspiece close to the level line.
- 🍎 At this point the ground where the two legs are sitting is level.
- 🍎 Now leaving the second leg in place, rotate the level and place the first leg in a new location that allows the freely hanging string to pass closely to the level line on the crosspiece.
- 🍎 Again the two legs will be on level ground.
- 🍎 A line that connects the places where the legs are placed when they are level will be a contour line.



*In practice, it is good to place a stake or mark every 5 to 10 rotations to mark the contour line*

# Exercises & Demonstration



# Steps for Establishing an Orchard

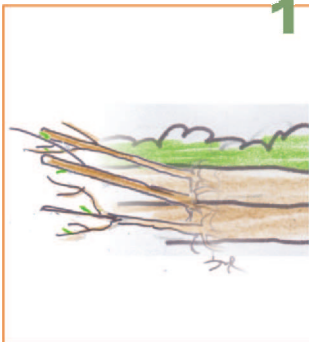


## Preparing to Establish an Orchard



Cover Crops

1



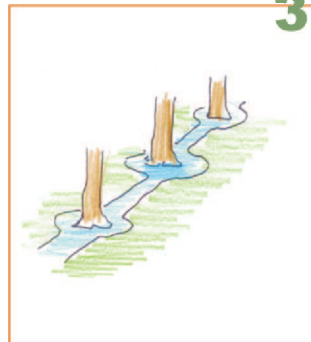
Remove grass & weeds

2



Install drainage

3



Soil test

4



Consider autumn and spring





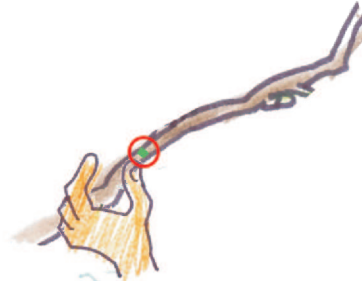
## Preparing to Establish an Orchard Planting Care

1



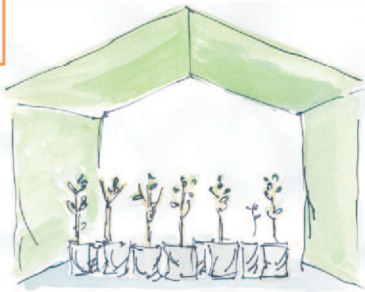
Only purchase trees that are dormant (without leaves)

2



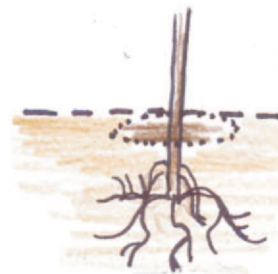
Do the thumbnail scratch test to check health of tree

3



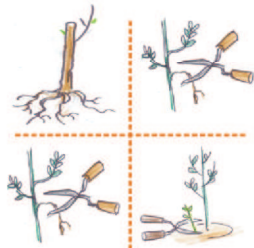
Keep your new trees in the shade until planting

4



Plant as soon as possible

5



Trim excessively long, misshapen, broken, and crossing roots before planting

6



Do not let roots dry out during the planting process

7



Soak bare root trees in water 8-12 hours prior to planting

8



If not planting immediately

- Store outside Heel in water well
- Keep watered until planting
- Maintain moist roots

## Preparing to Establish an Orchard Your Trees



1



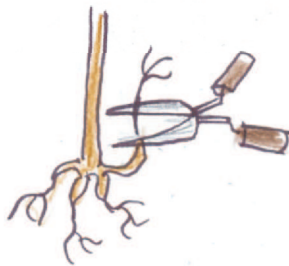
Dig as big a hole as you can

2



If soil is poor add some well rotted organic matter.

3



Spread roots out to avoid crowding. No J roots

4



Plant to the same depth root collar.

5



Keep graft union a few inches above soil line.

6



Incline tree slightly in the direction of prevailing wind (1 to 5 degrees).

7



Use a board to judge the correct planting depth for new tree

8



Refill hole half way and tamp soil or add water to avoid air pockets.



## Preparing to Establish an Orchard Your Trees

9



Finish filling hole and  
tamp soil again.

10



Apply 10 to 20 l of water  
to settle soil around roots.



Do not leave a sunken place around the trunk



Do not use fertilizer at planting time

## Preparing to Establish an Orchard Post Planting



### Protection of Trees & its Care

1



Trunk wraps, fencing & protection from animals

2



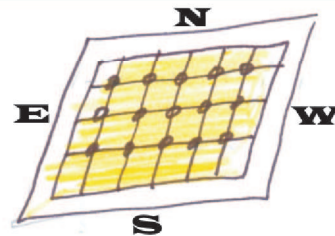
Permanently identify each tree.

3



Dwarf trees need to be supported forever.  
(Trellis, wires, stakes, poles)

4



Make a map of your plantings and keep it in a secure location

### Irrigation

1



Every 2 days for the first two weeks

2



One deep watering is better than several shallow ones

3



Trees need roughly 20 - 25 L of water per week.

4



Mulch can be placed around the tree, and in tree rows but should not contact the trunk





## Orchard Floor Management

### Inter Cropping with Fruit Trees



#### Competition

For water, nutrients, light, space, air



#### Facilitation

Providing support, nutrient

#### Suitable Crops

#### Less-suitable Crops

Peas	
Fresh beans	
Dried beans	
Fava beans	
Chickpeas	
Lentils	
Legume forages Clover, alfalfa, vetch	

Okra (ladyfingers)	
Cucumbers	
Peppers	
Tomatoes	

#### Alternative approaches

Cereals medicinal plants	Clean Cultivation	Cultivated Middles	Meadows	Mulching	Ring Cultivation

## Intercrops in Orchard

Examples



*Growing fresh beans with apples to manage understory*



*Leguminous forages with apples to manage understory*



*Leguminous food crops with pear to manage understory*



*Sod aisle ways, herbicide strip under trees*



*Understory management*

