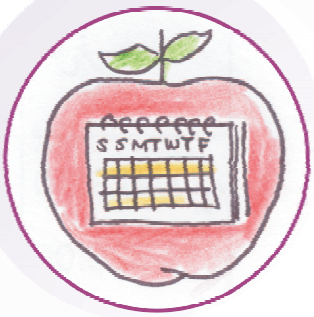
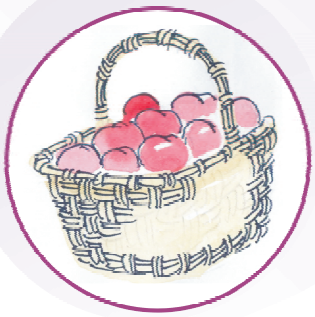
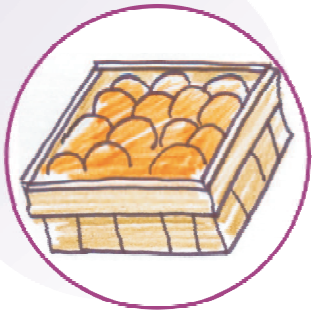
INTEGRATED ORCHARD MANAGEMENT GUIDE

Handbook

Introduction to Fruit Production







March 2008

USAID
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CNFA I-LED

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

Forward

Overall, the module aims to provide basic understanding of the parts and functions of fruit trees and how the characteristics of a tree affect the production of commercial quality fruit in small orchards and farms.

01

Objectives

By the end of the training participant will be able to:

1. Explain a tree's life cycle, its parts, function, and role in fruit production.

2. Distinguish between rootstocks and varieties, and explain there importance and role of rootstocks in production of an effective fruit tree.

3. List the characteristics that that fruit varieties influence, and the effect these would have on fruit yield.

4. Explain the effect of various elements (sunlight, temperature, water, tree size, soil, etc.) on fruit trees and the quantity and quality of fruit produced.

5. Define the different aspects of commercial fruit production, and the training and support needed for success.

Session 1

Tree Anatomy

Handout
02

Why Learn About Fruit Trees?

We need to understand the trees to be able to take care of them

Well Cared for trees

- Produce more fruit
- The fruit is larger
- The fruit is cleaner
- The trees are easier to pick
- We earn more money from

well tended trees than from poor trees

Handout 03

Where Do Good Fruit Trees Come From?

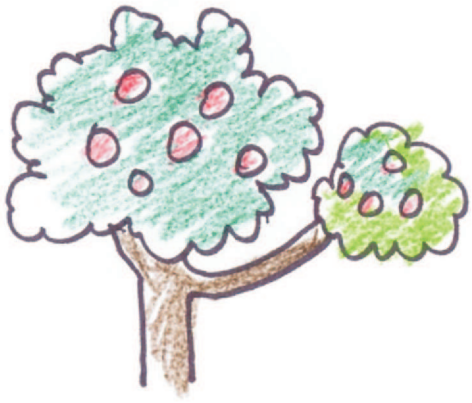
1

People have been cultivating fruit trees for 1000s of years.

2

Wild trees with good fruit were initially selected.

3



Rapid improvements recently with breeding and recurrent selection for better fruit have improved the old verities.

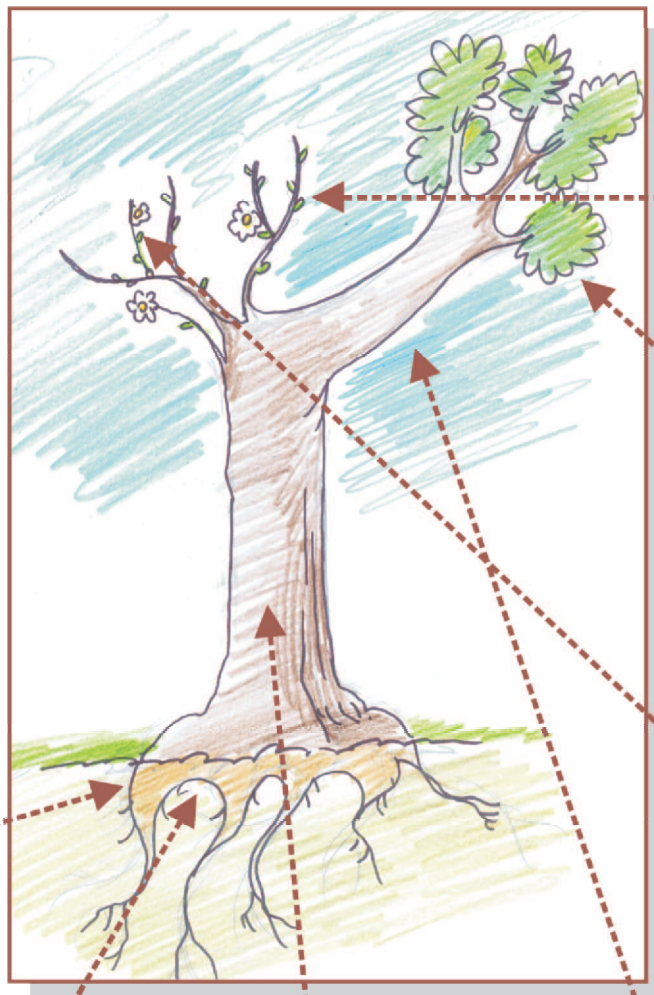
4

Many quality varieties have been found – rather than developed.

Handout
04

Fruit Tree Anatomy

To take good care of the trees, it is important to know what the parts of the tree are, and what purpose they serve in the tree's life. We can then better understand what the tree needs from us.



I Roots

II Root Collar

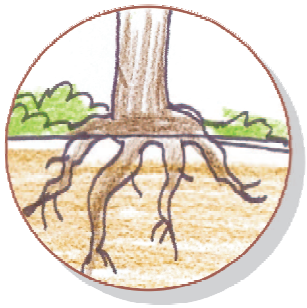
III Trunk

IV Branches

V Fruiting Wood

VI Leaves

VII Buds



I - Roots

What are their Role?

1

Supports the tree to remain upright.

2

Transports water from the soil to the leaves.

3

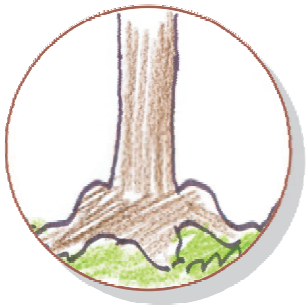
Helps the tree to get the nutrients it needs from the soil.

4

Provides a storage location for extra sugars and other resources to be used during the winter.

5

Is much larger and wider than the tree part above the ground.



Handout
06

II - Root Collar

What is the Role of Root Collar?

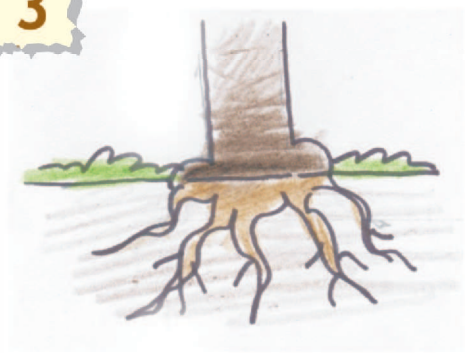
1

Defines the change between the above ground and below ground parts of the trees.

2

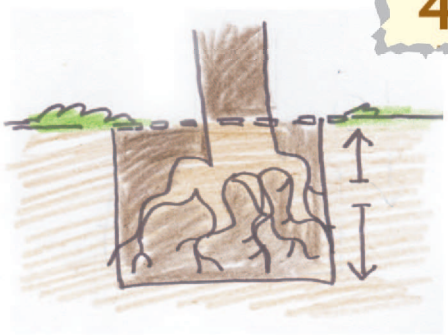
Is at level with the surface of the soil.

3

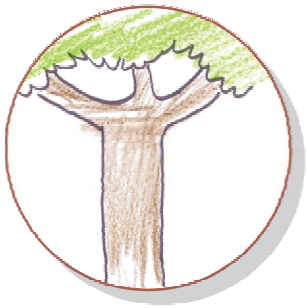


Is visible because of a change in color and texture.

4



Is useful to determine how deep to plant the tree.



III - Trunk

What Does the Trunk Do for a Plant?

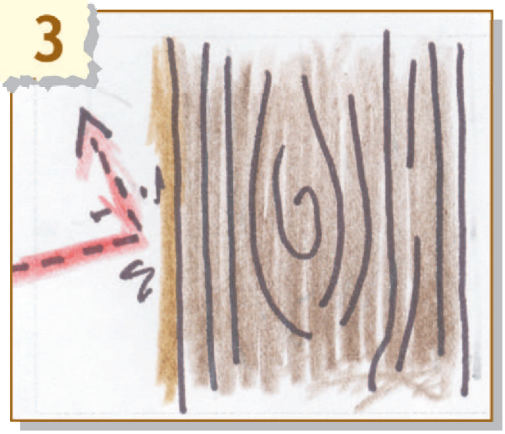
1

The trunk serves to conduct water, sugars, and nutrients between the roots to the branches, leaves and fruits.

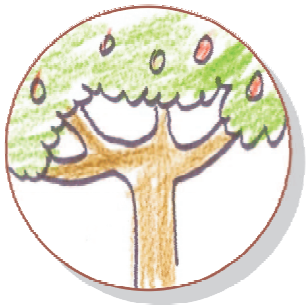
2

The trunk also supports the above ground part of the tree.

3



Trunks and branches are normally covered with bark which protects the tree against diseases, insects, and from drying out.



Handout 08

IV - Branches

Is the Function of a Tree Branch?

1

Branches are an extension of the trunk.

2

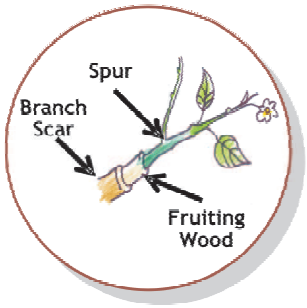
Branches are formed by the growth of small buds which become twigs and then branches.

3

Branches do not move up the tree as the tree grows. Each main branch is essentially independent.

4

Main branches do not normally support each other with nutrients or energy.



V - Fruiting Wood

What is Fruiting Wood?

Handout 09

1

Fruit wood is mainly small branches where the majority of flower buds form.

2

Spurs are short branches which remain short and produce flowers and fruit year after year.

3

Most fruit is produced on branches that grew the previous year, indicated by branch scar.

Handout 10

VI - Leaves

What is the Role of Leaves?

1

Leaves are the main source of energy for trees.

2

New leaves are produced every spring and normally last one season until they are shed in the fall.

3

Leaves often indicate the health of a tree with regard to nutrients.

Sunlight

Carbon di oxide + water---------- ----------Food/sugar + oxygen

green pigment in leaf

Handout 11

Leaves of Common Fruit Trees

What is the Role of Leaves?

1

Apple

2

Pear

3

Apricot

4

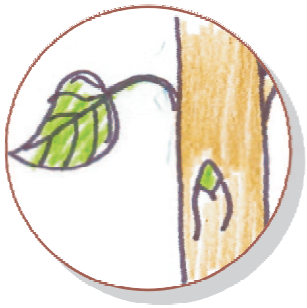
Plum

5

Peach

6

Walnut



VII - Buds

What are Buds?

Most buds form in the junction between a branch and a leaf (axil) and are easily seen when the leaves have fallen.

There are two kinds of buds:

Vegetative

Vegetative buds produce leaves, and eventually new branches.

Flower

Flower buds produce flowers, and eventually fruit.

i - Flowers Buds

What are Buds?

1

Flowers emerge only from flower buds.

2

Flower buds develop where the sun shines on the branches.

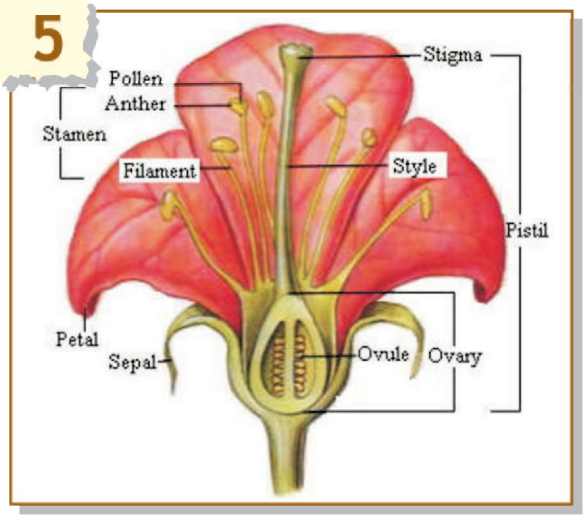
3

Flowers grow most often on branches that are growing horizontally.

4

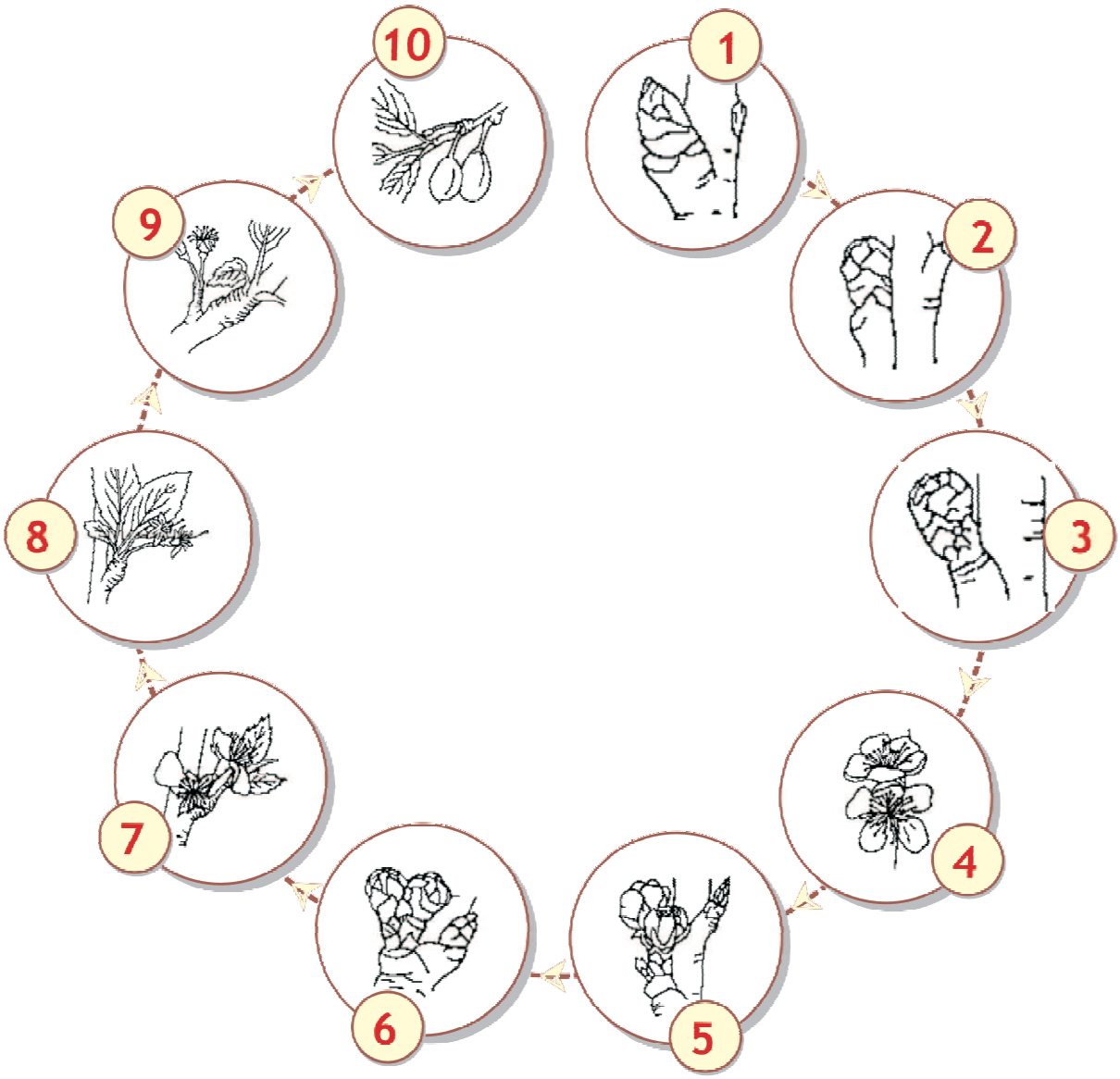
Flowers need to be pollinated in order to produce fruit.

5



Handout
14

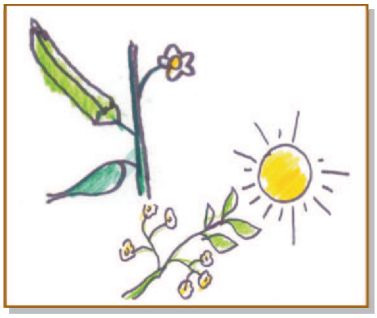
Apple Flowers Development Cycle



Handout 15

ii. Vegetative Buds

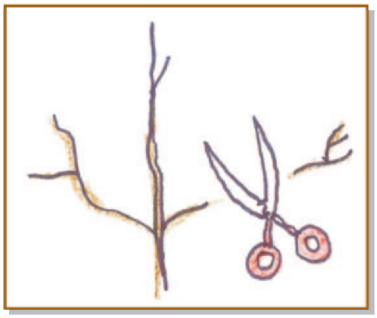
Vegetative buds produce leaves, and eventually new branches.



It is usually possible to distinguish flower and vegetative buds by shape and size.

The vegetative buds closest to the end of the branch will grow the soonest and fastest.

Buds further back from the tip may not grow at all - dormant buds.

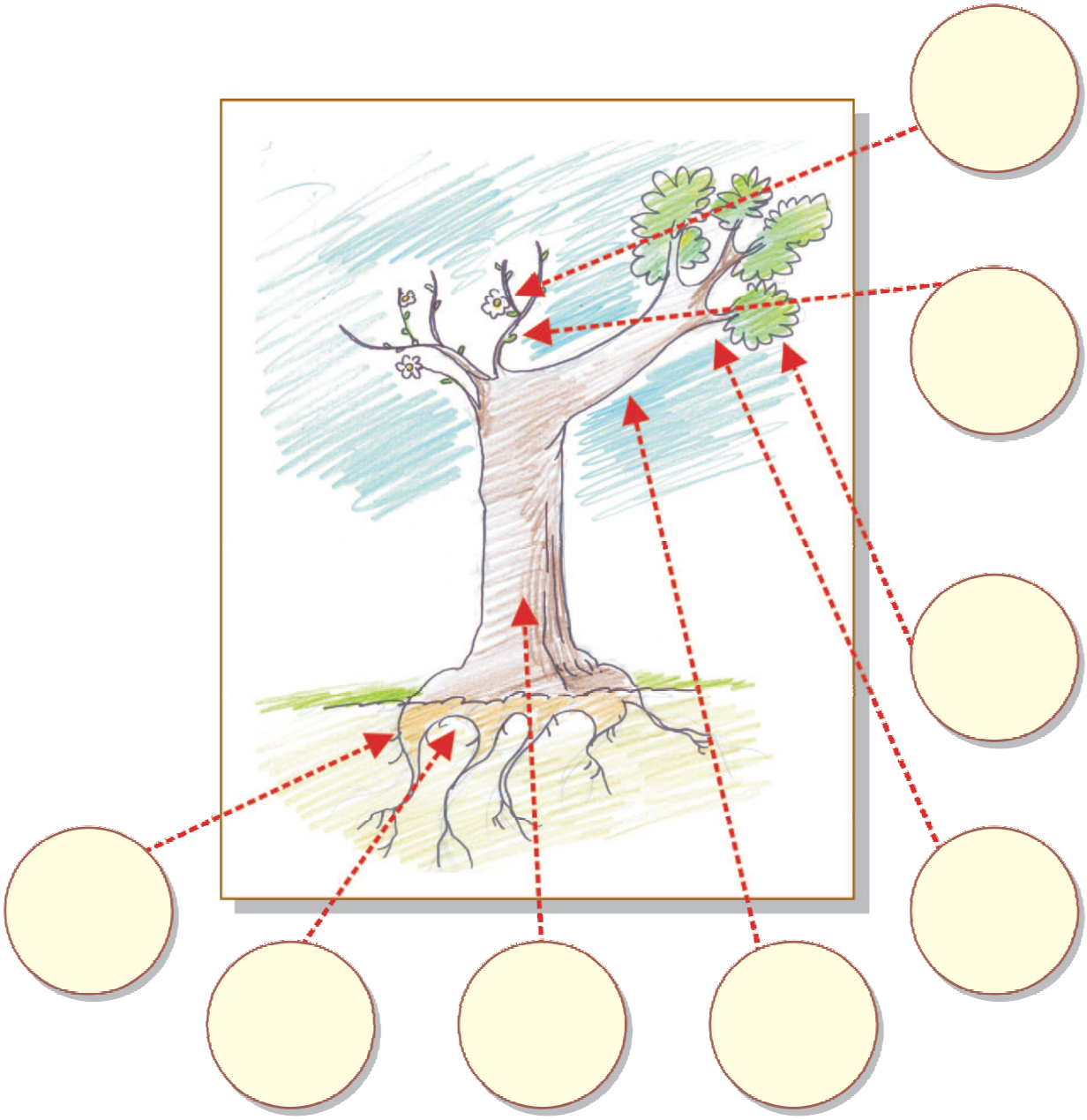


Pruning helps to control which buds grow and how much.

Exercise - 1

Instructions

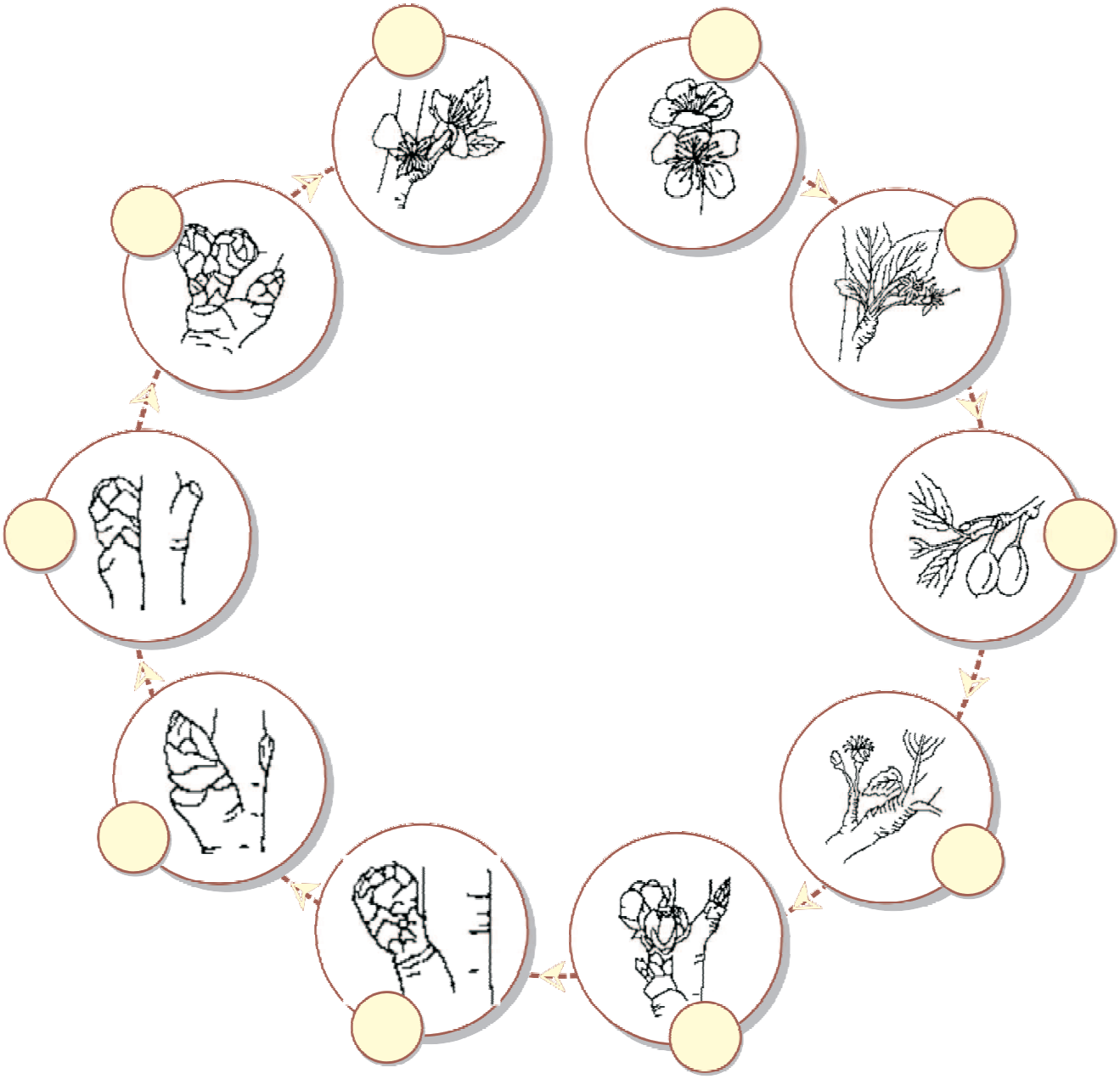
- Divide up the participants into 6 groups.
- Take the participants and in the open field where many different kinds of trees are visible.
- Ask each group to "adopt" a tree and identify each part of the tree as discussed in the session.
- Ask then to put the name of the part on this sheet.
- Point each part of the tree and ask participants to name the part.
  Go up the each group and confirm their marking, and discuss the important of each part



Exercise - 2

Arrange the following in Sequence

Number the following in the sequence in which growth occurs.



Session 2
Rootstocks

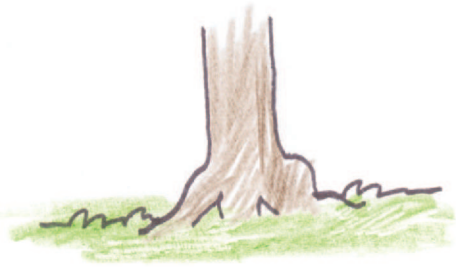
Handout 16

I. Why use Rootstocks?

1

Modern commercial fruit trees are always created by joining two trees together with grafting of some type.

2



The bottom part of the tree is called the rootstock.

3

The upper part is the scion or variety.

4

This practice allows growers to combine excellent roots with excellent fruit quality.

II. What is a Rootstock?

1

Rootstocks are nothing more than fruit trees produced from seeds or cuttings.

2

The tops are cut off and a chosen variety of fruit grafted either by grafting or budding.

3

Rootstocks are selected for the special characteristics they give to a tree and for the ease of producing them.

III. Rootstock Come From?

1

Some rootstocks have been bred in scientific programs to produce trees with special features.

2

Others are produced from seeds of trees which naturally show desirable traits.

3

With some fruit type very little work has been done and almost any rootstock will be acceptable.

Exercise - 3

What Characteristics do Rootstocks influence?

What do you understand by each of the following?

Cold Tolerance

Drought Tolerance

Tree Vigor

Tree Size

Early or Late Bearing

Resistance To Pests and Diseases

Performance on Wet Sites

Life Span---Old OR

IV. What Characteristics do Rootstocks Influence?

Cold Tolerance

1. Trees that naturally grow in locations that are cold are better able to withstand cold winter conditions otherwise they would not survive.

2. Rootstocks produced from parent trees from cold winter areas result in trees that are better adapted to cold.

Drought Tolerance

1. Some rootstocks have root systems which penetrate the soil better to reach water that may be available so they are better able to withstand dry periods and droughts.

2. Seedling rootstocks may be inherently more drought tolerant because of their more vigorous roots.

Handout 20

V. Trees Characteristics

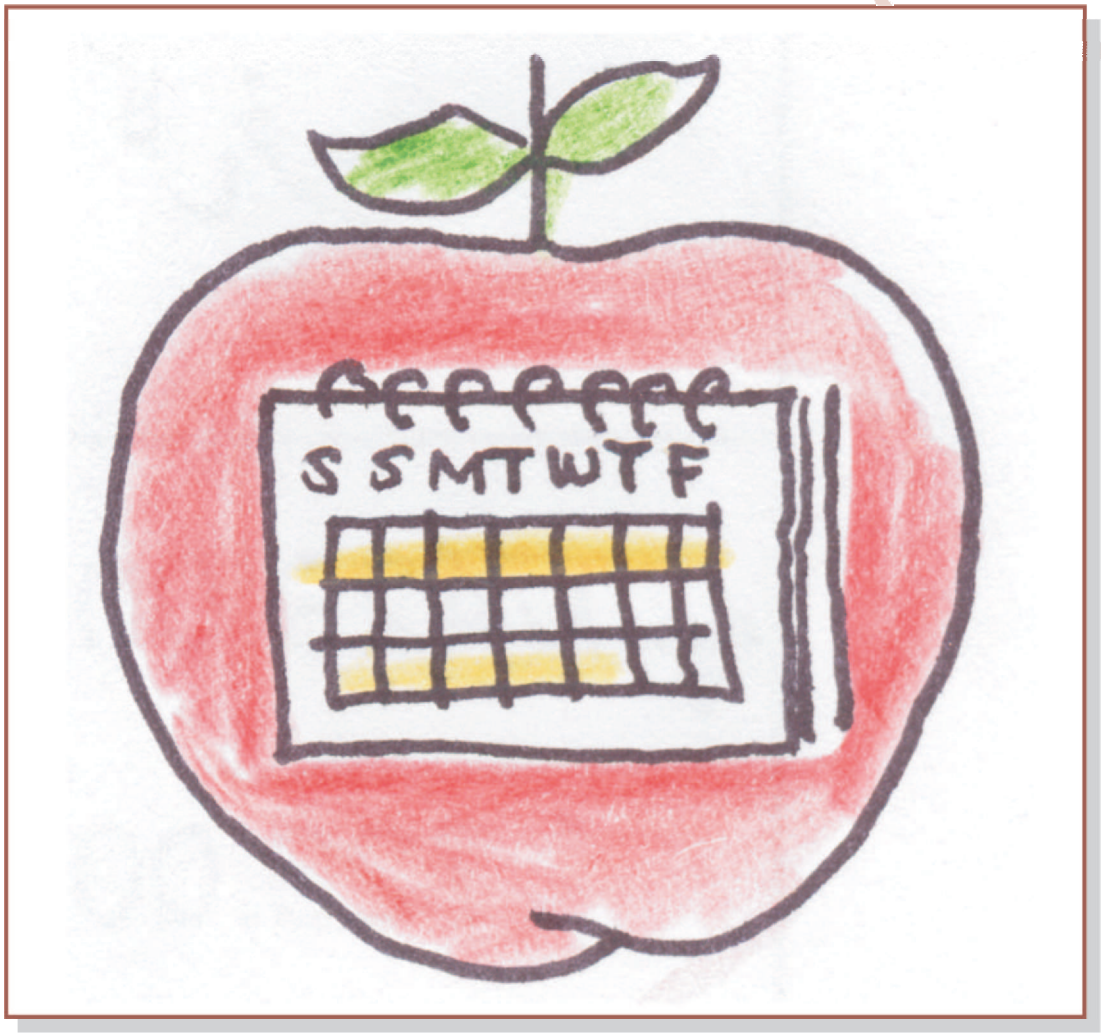
Tree Vigor - Fast Growing and Large

1. Tree vigor or strength to grow is provided by both rootstock and variety.
2. Seedling rootstocks produce more vigorous trees than most clonal rootstocks.
3. Cool climates and a short growing season will reduce the vigor of rootstocks from seedlings as well as from cuttings.

Tree Size

1. Most rootstocks produced from cuttings have been chosen to produce small less vigorous trees, trees that begin producing sooner, or trees that are free of diseases that can be passed through grafting.
2. Seedling trees are usually the largest and are called standards. Semi-dwarf and dwarf rootstocks are generally produced from rooted cuttings.

Early or Late Bearing



Some rootstocks have been observed to promote the variety that is grafted on them to produce fruit earlier.

The effect is strongest on the most dwarfing rootstocks and may be caused by the stress that the tree experiences.

Grafting varieties onto rootstocks results in early fruit bearing trees then if that variety was grown from seed.

Early or Late Bearing

While most work on rootstocks has been to reduce tree size and produce fruit earlier, disease and pest resistance are also an important consideration.

Some rootstocks are more resistant to wooly apple aphid, phytopthora, pear decline, collar rot, fire blight, etc.

Early or Late Bearing

Performance on wet soil

Some rootstocks are more tolerant of very wet conditions

Life span---old or young

Some rootstocks do not live long while others may live 100 years

Exercise - 4

How can you affect tree growth through selection of Rootstocks?

1 .....

2 .....

3 .....

4 .....

5 .....

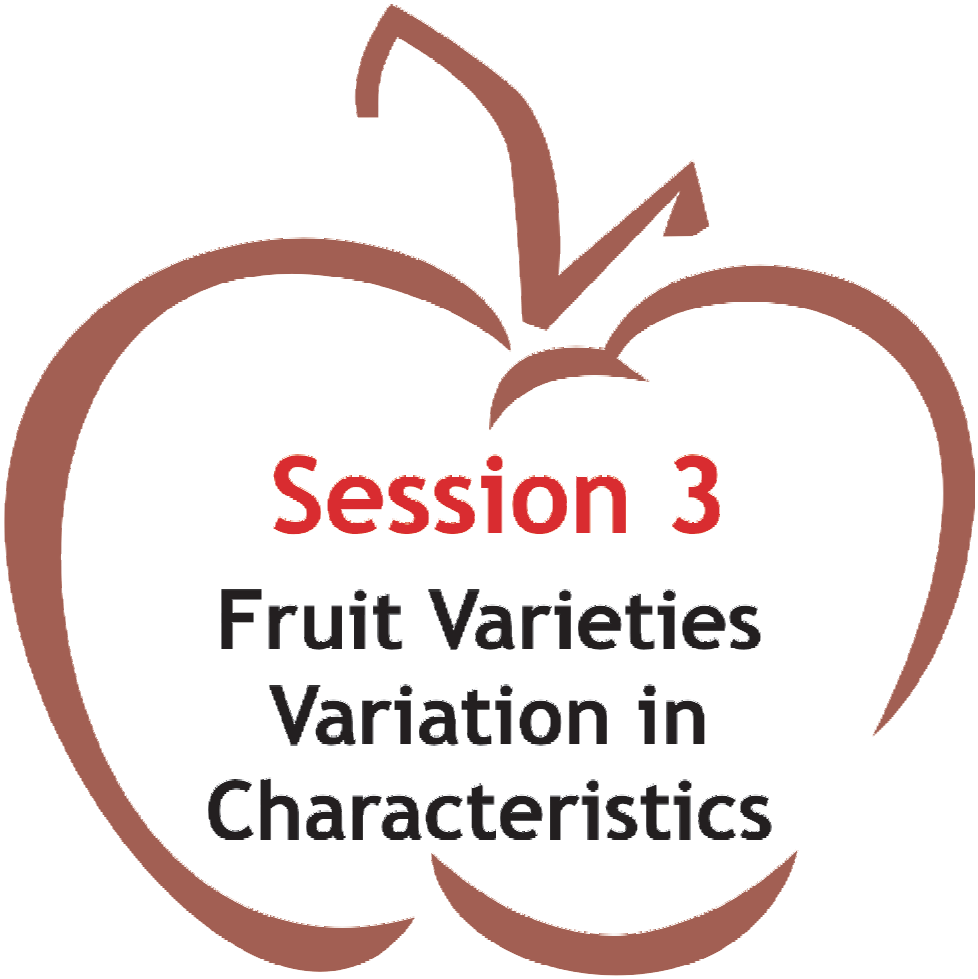
6 .....

7 .....

8 .....

9 .....

10 .....



Session 3

Fruit Varieties Variation in Characteristics

Handout
24

Importance of Scion Variety

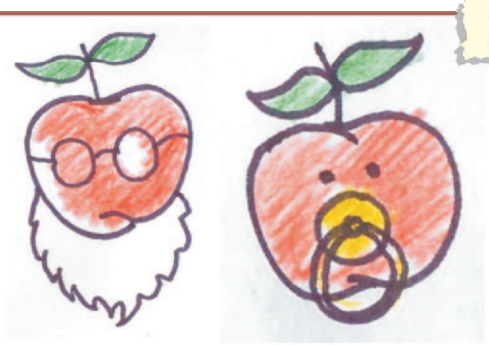
1

Because specific fruit varieties will not be obtained from planting the seeds of that fruit, the variety must be reproduced by grafting a branch onto a rootstock.

2

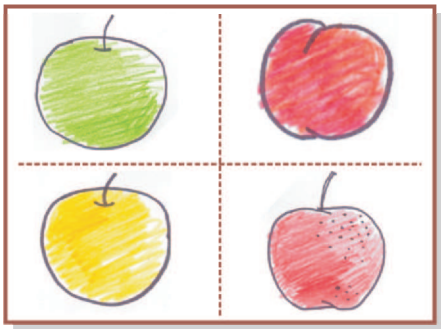
The combination of rootstock and scion also produces fruit earlier than trees produced from seed

3



The practice also permits growers to keep good quality fruit varieties and produce large quantities of them for production

What is a Fruit Variety?

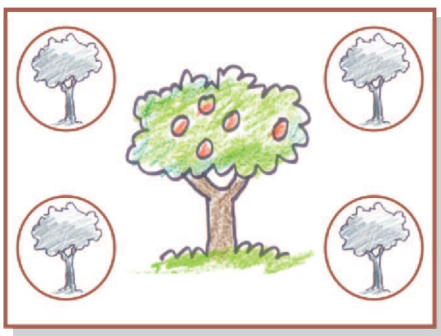


A fruit variety is a specific kind of fruit with recognizable characteristics.

Fruit varieties are always produced from taking cuttings of trees and making new tree with grafting.

Fruit varieties may old or new. New varieties keep emerging and are selected and named.

New varieties are only selected and named if they are better than the old varieties to which they are similar.



Varieties are selected for specific characteristics which may or may not be important to farmers.

Handout 26

What Characteristics Do Fruit Varieties Influence?

Physical Characteristics

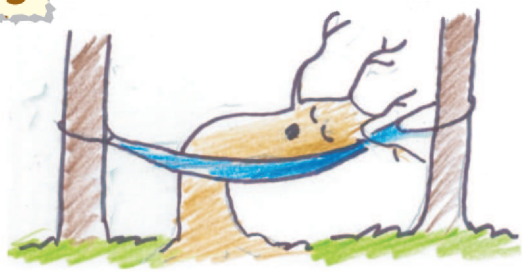
1

Flowering date

2

Tree Age and Yield (Age to begin bearing fruit)

3



Dormancy requirements

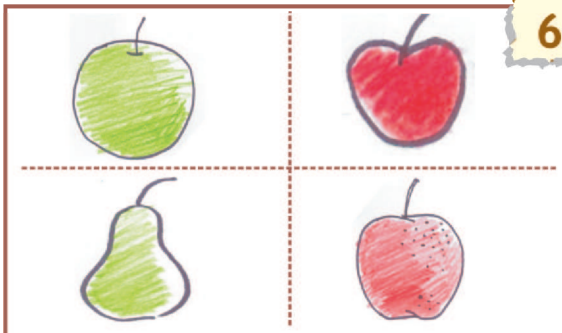
4

Resistance to diseases and insect pests

5

Ripening dates

6

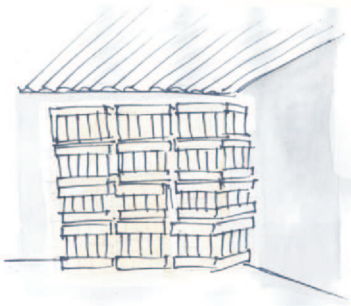


Physical Characteristics
(fruit size, color, shapes and flavor)

7

Hardiness

8



Suitability for storage

I. Flowering Dates

1		When a tree's flowers open is controlled by the scion variety and weather.
2		Very cool conditions delay flowering, warm conditions cause it to happen earlier.
3		Some varieties flower early, others very late, and some in-between.
4		Most fruit varieties require another variety to be available for pollination.
5		Good varieties for cross-pollination will have flowers at the same time.

Handout
28

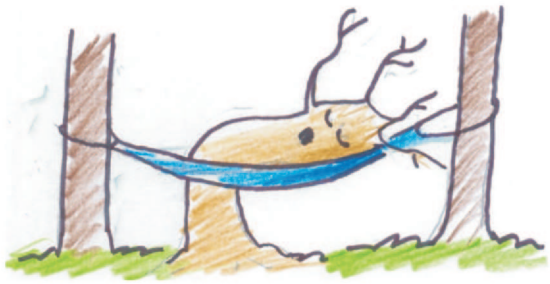
II. Tree Age and Yield

The variety changes how old the tree is when it flowers. Some varieties flower in the 2nd year while others may not flower until 7 & 8 years old.

Handout 29

III. Dormancy Requirements

1



Deciduous fruit trees require a period of rest or 'dormancy' during which they have no leaves and show little to no signs of growth.

2

When they have rested they are ready to begin growing again.

3

Some varieties require more rest than others.

4

If the winter is too short, trees may not rest adequately and growth may be negatively affected.

Handout 30

IV. Resistance To Pests and Diseases

1

Both rootstocks and varieties contribute to resistance to pests and diseases.

2

Resistance to

Firelight
Scab
Mildew
Rust

are a few of the diseases for which resistant varieties have been identified.

3

Resistance is also present for brown roots and peach leaf curl.

V. Ripening Dates

1

When fruits will mature is affected by the variety and the weather.

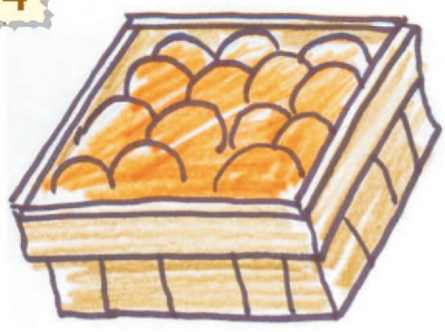
2

If the season is very warm, fruits will mature sooner, and where conditions are cooler, maturity will occur later.

3

Some varieties normally mature in the summer, while other do not mature until late fall.

4

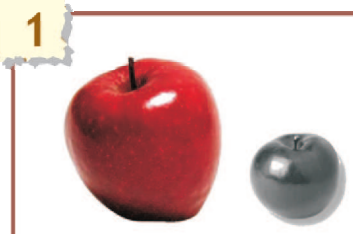


Late maturing varieties are usually better suited to being put into storage.

Handout
32

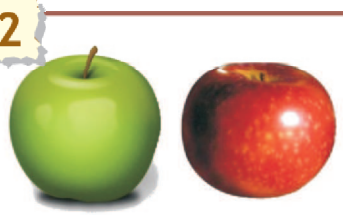
VI. Physical Characteristics
(Fruit Size, Color, Shape, and Flavor)

1



Size is mainly controlled by the genetic potential of the variety, availability of nutrients and water, and the number of fruits on the branch.

2



Color comes from the fruit Variety, the stage of maturity or ripeness, and the amount of sunlight which reaches the fruit.

3

Good color is an important factor in harvesting and selling fruit.

4

Shape is strongly determined by variety. However, insect damage or poor pollination can affect fruit shape (usually badly).

5

Flavor is affected by the fruit variety, but also by the nutrients in the soil, by tree management, by the number of fruits, and weather.

VII. Hardiness

1

Some varieties are more tolerant of very cold conditions than others, and this is called hardiness.

2

Both the rootstock and the varieties contribute to how hardy the tree will be.

3

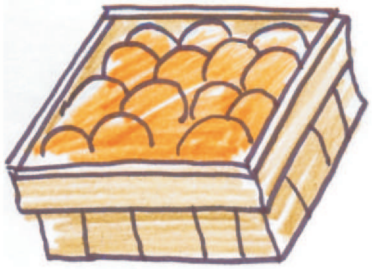
Tolerance to cold temperature develops in the fall as temperatures become cooler, so even a very hardy tree can be damaged by an unusually early freeze.

Handout
34

VIII. Suitability

For Storage

1

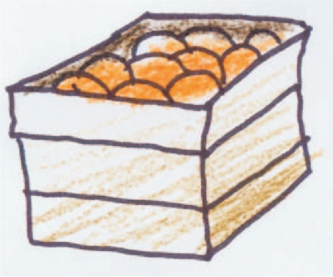


Some fruit varieties have excellent storage qualities.

2

Late maturing apples and pears can be stored longer than early maturing.

3



Stone fruits cannot be stored for more than 2 to 3 weeks without large losses in quality.

Apple

Better Storage Apple Varieties:
Liberty, Lobo, Premevere, Granny Smith, Freyburg.

Pear

Better Storage Pear Varieties:
Clapps Favorite, Aurora, Gorham, Conference, Comice, El Dorado.

Exercise - 5

Which fruit varieties are most profitable and why?

Fruit	1	2	3	4
 Apple				
 Pear				
 Peach				
 Plum				
 Cherry				

Session 4

Fruit Quality & Quantity

Handout
35

Factors Influencing Fruit Quantity & Quality

1

Location

2

Temperature

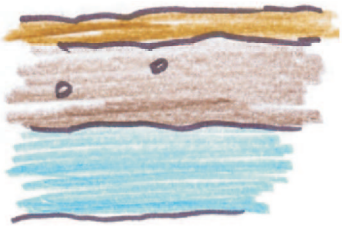
3

Frost

4

Soil Type

5



Fertility

6

Water Availability

7

Light

8

Timing

9

Humidity and Disease

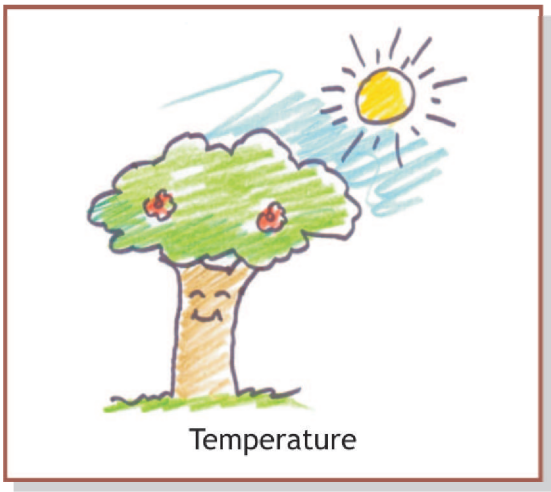
10

Effect of Tree Size and Age

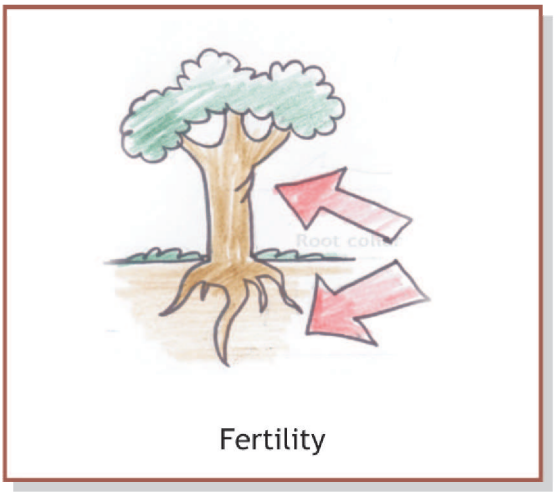
Handout 36

I - How Does Location Influence a Tree?

Where a Tree is Planted will Determine

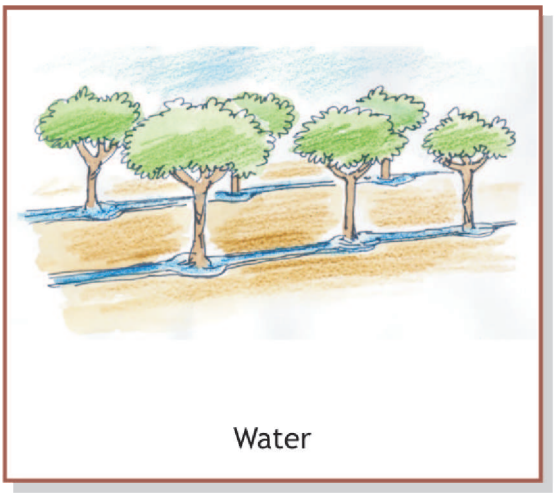


Temperature



Fertility

Soil



Water

II - Temperature

Temperature Effects Plant Growth

Plants grow faster in warmer conditions.

Plants grow slower in colder conditions.

Warmer conditions also promote fast and rapid growth of insects.

Different temperatures prevail on land slopes. Tree is late growth on northern & Eastern slopes compared to Southern slopes.

Handout 38

III - Frosts

Frosts can occur anywhere, and can Damage Leaf, Fruit, and Flower

It is more common in valley bottoms than on hillsides.

To avoid frost, do not plant trees at the bottom of hills.

Fruit trees are most vulnerable to frosts during and after flowering.

Damage & Loss (by Frost)

Leaf

Fruit

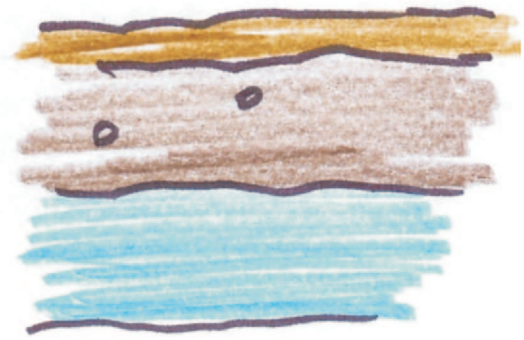
Flower

Handout
39

IV. Soil Types

Orchard

Sandy



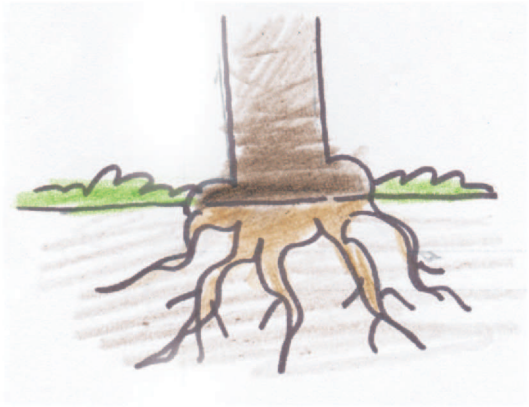
Clay

Maize production Soil

Handout
40

V. FERTILITY

Trees require nutrients to grow and produce good yields of quality fruit for many years.



Trees require nutrients to grow and produce good yields of quality fruit for many years.

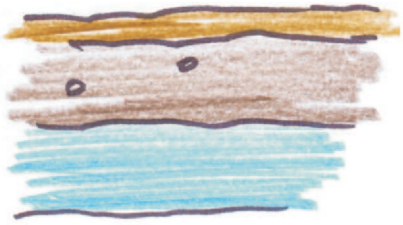
Testing of soil fertility before planting the orchard is a good practice as major deficiencies can be adjusted before planting.

VI. Water

AVAILABILITY

Fruit is mainly water (85%), so any limitation in the amount of water can reduce the yield of your crop substantially.

Water is critical for good fruit development after flowering - and before maturity.



Water availability is higher in clay soil.

Where soils are sandy or rocky more frequent irrigation will be required.

AMOUNT

Trees use water continuously to allow them to produce sugar in their leaves, but most of this water passes out through the leaves and returns to the air. Most of the water is used this way.

Smaller amounts of water is required for fruit growth, but unavailability will reduce production.

VII. Effects of Light

Light is the critical component in orchard production - simply put, the more light we catch with the trees, the larger the possible yield will be.

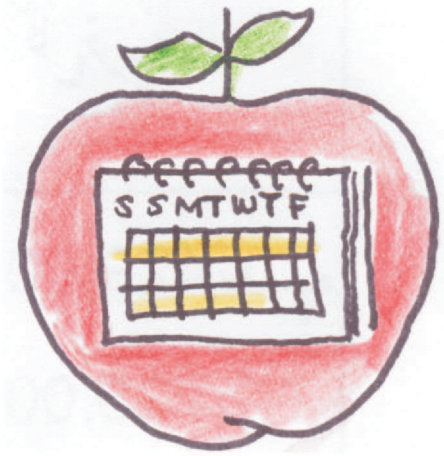
Flower buds will form more often on branches where the light shines.

Fruit will grow larger and better colored when they are growing where the light reaches.

When tree shape or management results in dense trees where the light cannot penetrate, fruit quality will be poor.

VIII. Timing

Water is critical immediately after flowering.



For 4 to 6 weeks before maturity water is again critical.

In both cases, the results will be smaller less valuable fruits and a loss in fruit yields from your orchard.

IX. Humidity & Diseases

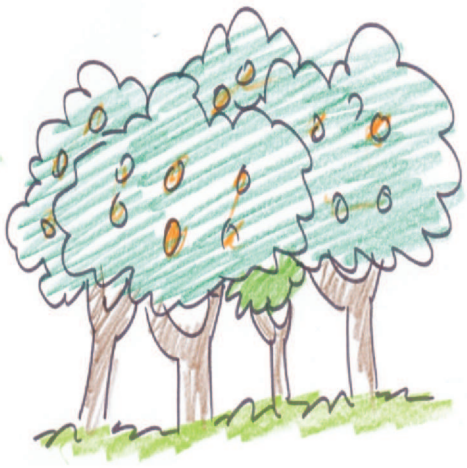
Dry areas are best for fruit production.

Rainfall conditions lead to the development of numerous diseases.

X. Effect of Tree Size and Age

The number of possible fruiting locations and the ability of the tree to support all of the fruit that is set after flowering generally increase as the tree grows older.

By 10 years production is maximum and will remain that way for 10 to 15 years.



Larger trees produce more fruit but also take more space, are difficult to prune, pick and spray.

Handout 46

Tree Competition With Other Plants

Plants normally grow together and share the basic requirements.

Trees often create shade which affect the crop production.

Trees have deeper roots than many crops and are able to access water.

Facilitation

- Competition occurs between all plants that are growing with trees
- Competition tends to reduce the growth and production of each plant or tree but the advantage goes to either the tree or the plant depending on what combination is present
- Grasses like maize, wheat, or pasture can be extremely competitive with fruit trees particularly when trees are young
- To deal with competition, we need to make sure that sufficient resources are present for both the fruit trees and the other plants that are growing with them

Competition

- Fruit trees are assisted by being grown with some crops such as legumes like peas, beans, lentils
- With proper management both the size and sugar content of the fruit can be increased by growing legumes in between the orchard

Recap

Session 1
Tree Anatomy

- WHERE DO GOOD FRUIT TREES COME FROM?
- FRUIT TREE ANATOMY (ROOTS, ROOT COLLAR, RUNK, BRANCHES, FRUITING WOOD, LEAVES, BUDS, FLOWERS, FLOWER PARTS, VEGETATIVE BUDS)

Session 2
Rootstocks

- ROOTSTOCKS AMD ITS IS
- WHERE DO ROOTSTOCK COME FROM?
- WHAT CHARACTERISTICS DO ROOTSTOCKS INFLUENCE?
- TREE VIGOR & TREE SIZE
- EARLY-LATE BEARING
- RESISTANCE TO DISEASES AND PESTS
- PERFORMANCE ON WET SOIL
- ROOTSTOCKS VERSUS VARIETIES

Session 3
Variation in Apple Characteristics in Enormous

- VARIETY EFFECTS?
- WHAT IS A FRUIT VARIETY
- WHAT CHARACTERISTICS DO FRUIT VARIETIES INFLUENCE (FRUIT SIZE, COLOR, SHAPE, AND FLAVOR, FLOWERING DATES, RIPENING DATES, HARDINESS, DORMANCY , EQUIREMENTS, RESISTANCE TO PESTS AND DISEASES, TREE AGE AND YIELD, SUITABILITY FOR STORAGE, STORAGE CONSIDERATIONS)

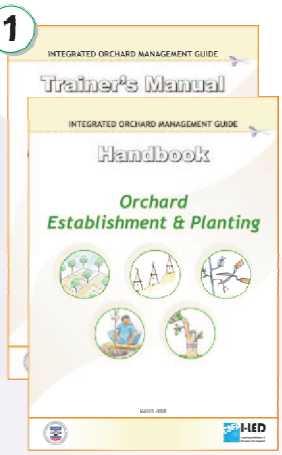
Session 4
Fruit Quality and Quantity

FACTORS INFLUENCING FRUIT UANTITY & QUALITY

- HOW DOES THE LOCATION WHERE A TREE IS PLANTED INFLUENCE IT?
- TEMPERATURE, FROSTS, DAMAGE BY LOSS BY FROST, SOIL TYPES, FERTILITY, WATER, EFFECTS OF LIGHTO, TIMING, HUMIDITY & DISEASES)
- TREE COMPETITION WITH OTHER PLANTS
- WHERE DO THE CROPS COME FROM?

INTEGRATED ORCHARD MANAGEMENT GUIDE

1



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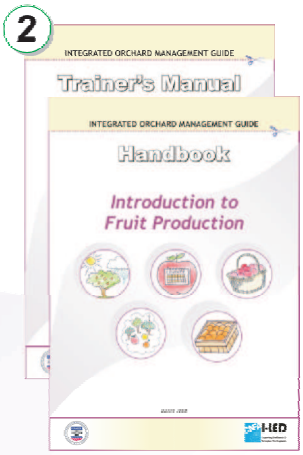

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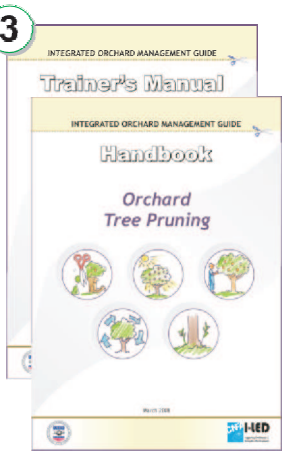

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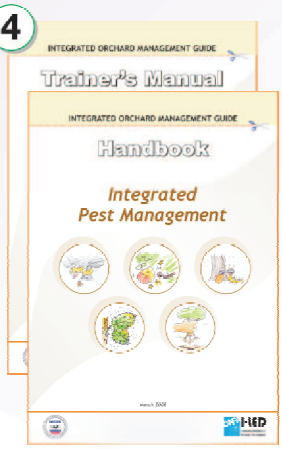

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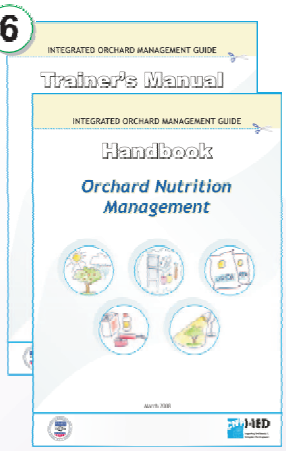

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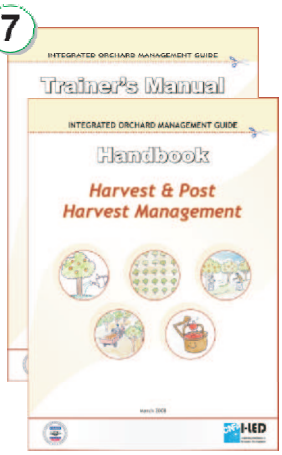

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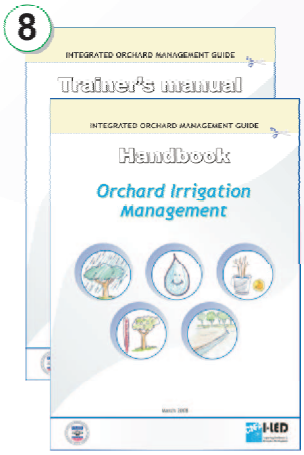

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