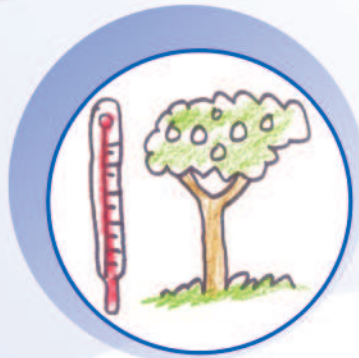




# Handbook

## *Orchard Irrigation Management*



November, 2008



**USAID**  
FROM THE AMERICAN PEOPLE



## 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



This training module focuses on presenting the importance of orchard irrigation. The purpose of this training is to provide sufficient information to the orchard growers to use irrigation techniques for better production growth, sale and good profit. Farmers will also provide the innovative irrigation methods and technique suits to different type of orchard, soils & produce.

The training will show results if the content is followed by demonstrations and hands-on activities. It is suggested that the training schedule confine the sessions for discussion, Q&A, demonstrations, the practical activities and hands on practice by participants.

The training material has been developed to make the Handbook relevant for semi-literate and non-literate participants.

## Objectives



By the end of training participant will be able to:

- 💧 Recognize the importance and benefits of irrigation.
- 💧 Understand the methods of irrigation & its suitability with their orchard & produce.
- 💧 Select the irrigation system and their common problems solutions
- 💧 Identify the equipment and accessories used in different irrigation system.
- 💧 Know Irrigation Tips and advantages / disadvantages of under and over watering.



## Structure of Module

1. **What is Irrigation?**
2. **Methods of Irrigation**
3. **Problems and Management of Irrigation System**



# 1

## *Session*

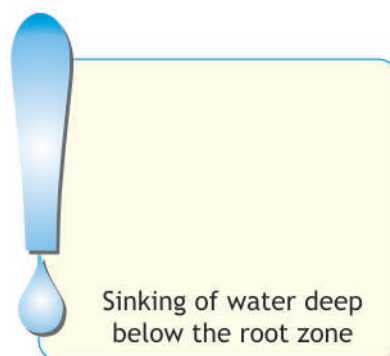
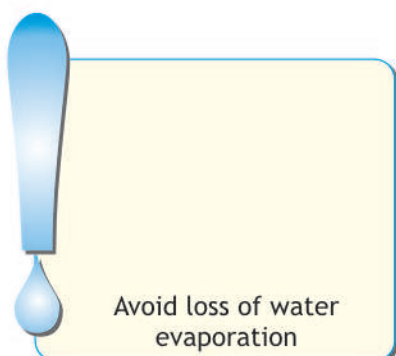
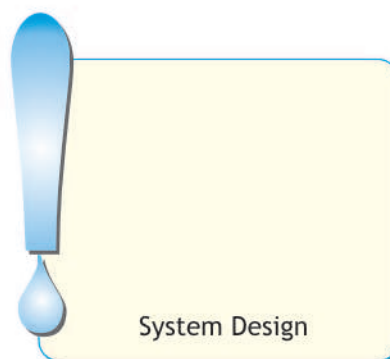
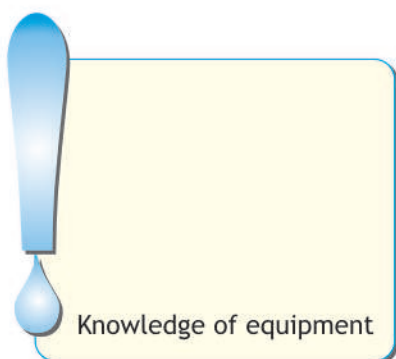
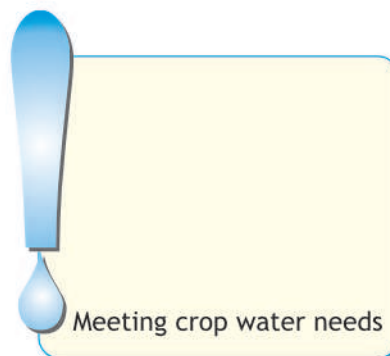
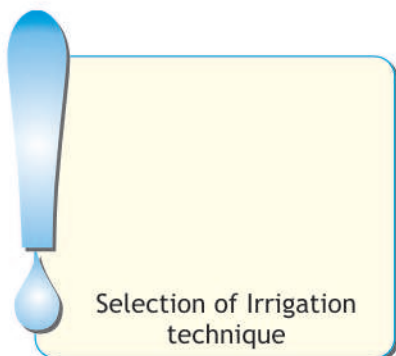
**What is Irrigation?**

## What is irrigation?

Irrigation has been around for as long as humans have been cultivating plants. Man's first invention after he learned how to grow plants from seeds was probably a bucket. Ancient people must have been strong from having to haul buckets full of water to pour on their first plants. Pouring water on fields is still a common irrigation method today -- but other, more efficient and mechanized methods are increasingly used with better results.



Key to maximizing irrigation efforts



## The Value of Irrigation

### Benefits for Primary Producers



Flexibility in their systems/operations



Ability to access water at times



Achieve higher yields and meet market/seasonal demands



Produce higher quality fruit



Lengthen the growing season



'Insurance' against seasonal variability and drought.



Maximize benefits of fertilizer applications



Irrigation makes Less productive area good for production



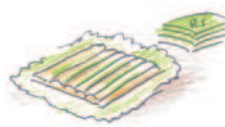
Market incentives for out of season production



Less reliance on supplementary feeding



Cost save/obtain greater returns.



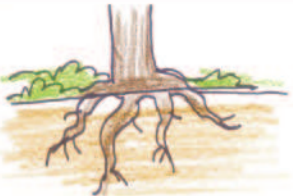






Improve the capital value of their property.



Water licensing agreements or 'water right' .?



## What are the effects of plant water stress?

1		Reduced root development
2		Reduced nutrient absorption and translocation
3		Reduced photosynthesis and growth
4		Reduced flowering, fruit and seed
5		Reduced fruit and vegetable size
6		Reduced fresh weight
7		Deformities, i.e. miss happened fruit



# 2

## *Session*

**Methods of  
Irrigation?**

## Methods of Irrigation



### Drip

A planned irrigation system in which water is applied directly to the Root Zone of plants by means of applicators (orifices, emitters, porous tubing, perforated pipe, etc.) operated under low pressure with the applicators being placed either on or below the surface of the ground.



### Flood

The application of irrigation water where the entire surface of the soil is covered by ponded water.



### Sprinkler

A planned irrigation system in which water is applied by means of perforated pipes or nozzles operated under pressure so as to form a spray pattern.



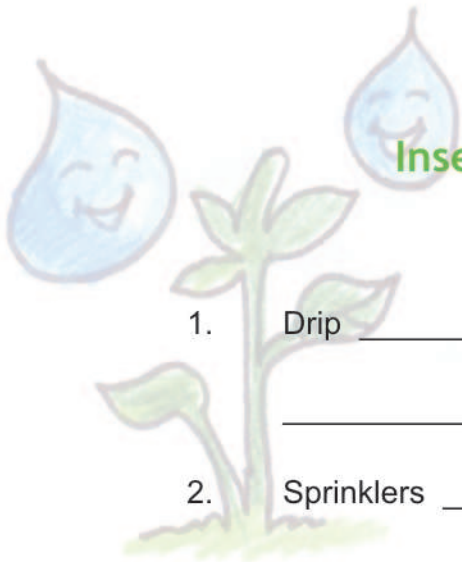
### Sub-irrigation

Applying irrigation water below the ground surface either by raising the water table within or near the root zone or by using a buried perforated or porous pipe system that discharges directly into the root zone.



### Traveling Gun

Sprinkler irrigation system consisting of a single large nozzle that rotates and is self-propelled. The name refers to the fact that the base is on wheels and can be moved by the irrigator or affixed to a guide wire.



## Insert Benefits and Disadvantages

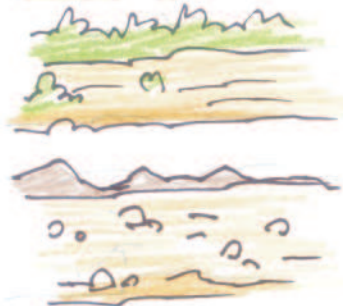


1. Drip \_\_\_\_\_  
\_\_\_\_\_
2. Sprinklers \_\_\_\_\_  
\_\_\_\_\_
3. Sub Irrigation \_\_\_\_\_  
\_\_\_\_\_
4. Furrow/Flood \_\_\_\_\_  
\_\_\_\_\_

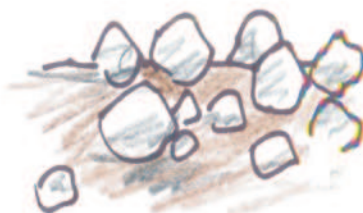
Type	Pros	Cons
Drip		
Sprinklers		
Sub Irrigation		
Furrow/Flood		

## Choosing an Irrigation System

There is a huge diversity in the types of irrigation technologies/systems used, which is attributable to the following:



Variations in soil types



Varying topography of the land



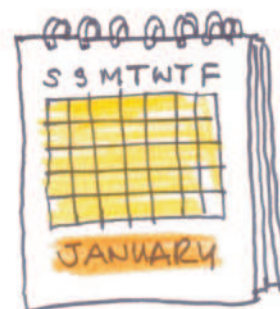
Availability of power sources



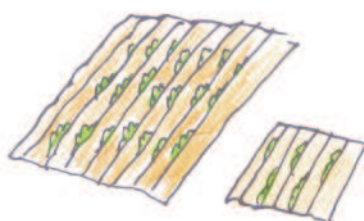
Type of crop



Sources of water



The period of time when irrigation required



The size of the area being irrigated



On farm water storage capacity



Availability of labour/financial resources

**TIP**

For Orchard Crops Drip and Micro-sprinklers are appropriate.

## Source of Irrigation Water

The vast majority of irrigation water use is pumped directly from a water source:

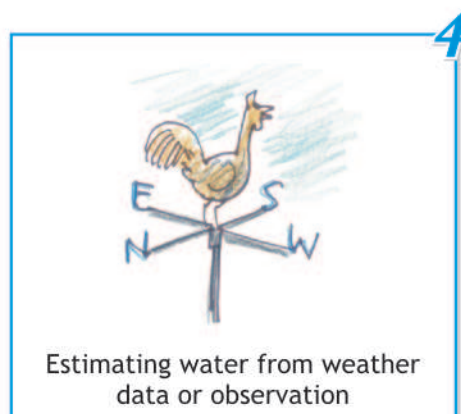
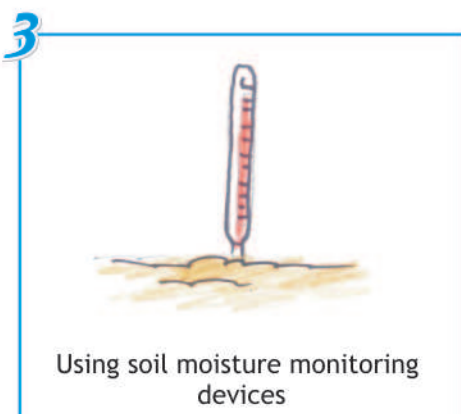
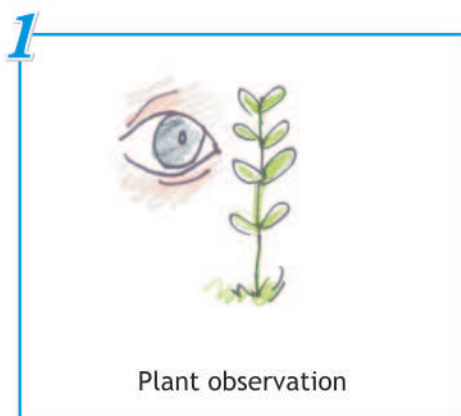
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
River	Creek	Channel
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Drag Line	Hole	Dam or Bore

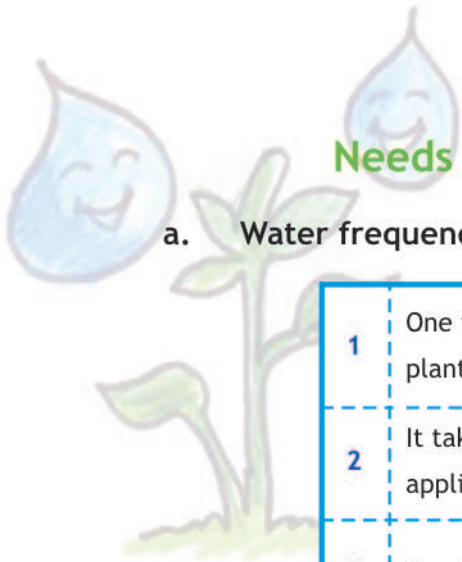
### Irrigation Scheduling

Irrigation scheduling is the process by which an irrigator determines the timing and quantity of water to be applied to the crop/pasture. The challenge is to estimate crop water requirements for different growth stages and climatic conditions.



To avoid over or under watering, it is important to know how much water is available to the plant, and how efficiently the plant can use it. The methods available to measure this include:





## Needs without complicated calculations

### a. Water frequency and soil moisture

1	One inch of water per week is the amount needed for plants to remain healthy in most soils.
2	It takes 27,000 gallons of water to equal one inch application to 8 kanals
3	One inch over 100 square feet equals 60 gallons

### b. Soil Water holding Capacity (Available Water)

Sand	.5 inches/cu. ft.
Loamy sands	.8 inches/cu. ft.
Silt loams	2.0 inches/cu. ft.
Silt clays	2.5 inches/cu. ft.

(Sands would need irrigation with less water but more often to meet plant needs of one inch per week.)

### c. Estimating Square Footage to meet Plant Water Needs (100 sq. ft. equals 60 gallons)

Vegetables	Trees and berries
calculate 2 sq. ft. per linear foot of row	calculate square footage to the drip-line

### d. Calculate Water Delivery

Time needed to fill up one gallon jug with delivery unit (hose, drip unit, sprinkler etc.).

Time needed per gallon X number of gallons needed equal total period of application.

## Monitoring water requirements

1



Visible changes in plant characteristics

2



Wilting of the leaves

3



Productivity may be lowered

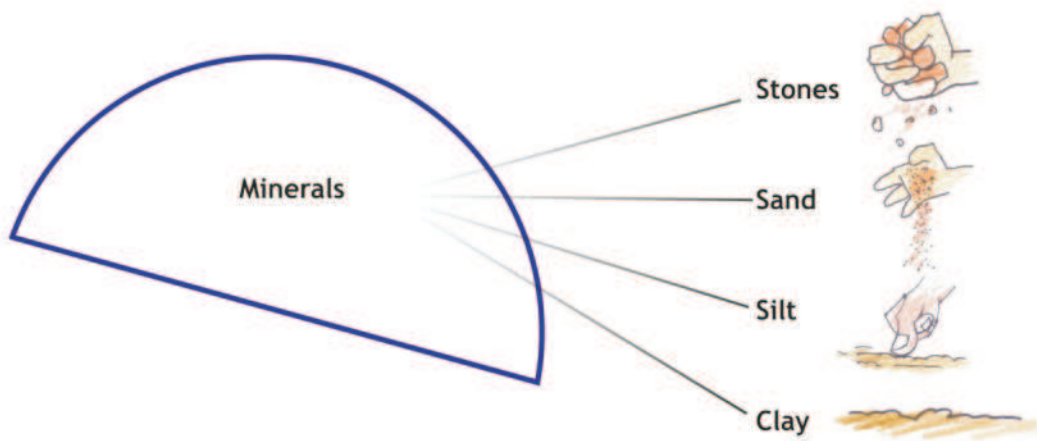
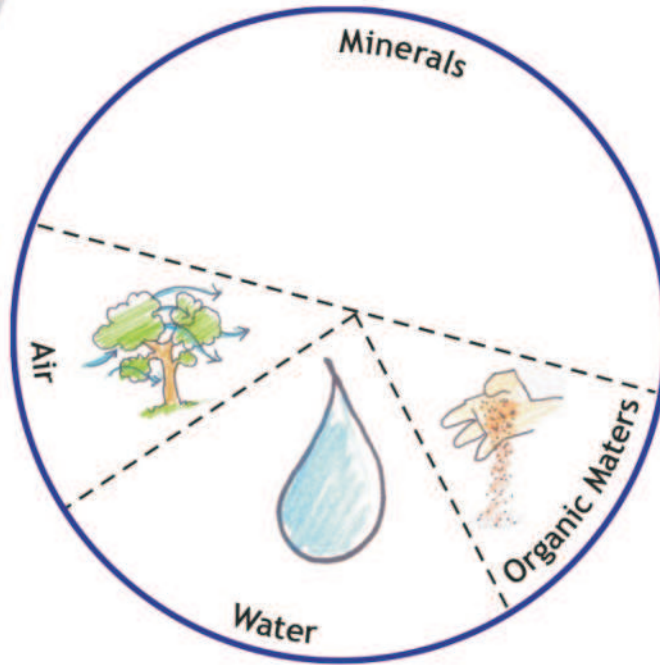
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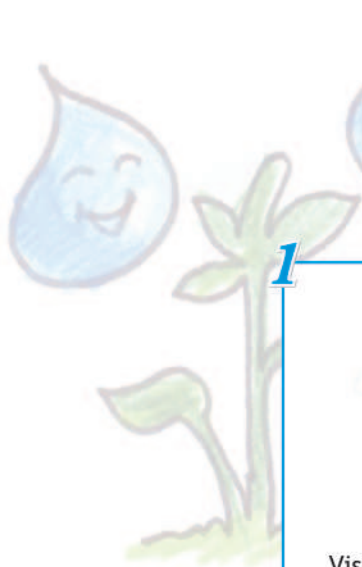
Catching and measuring rain water



### Soil Composition



## Feel and appearance of the soil



1



Visual observation and feel of the soil



Monitor moisture levels of paddocks and hence

3



Sustain plant growth



Observing the appearance of the ball and creating a ribbon

5



Slightly coherent



Dry, loose, flows

7



Through fingers



Crumbly and powdery



# 3

## *Session*

### **Problems and Management of Irrigation System**










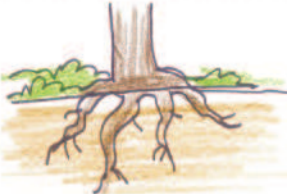


## Problems with irrigation

A - Over water

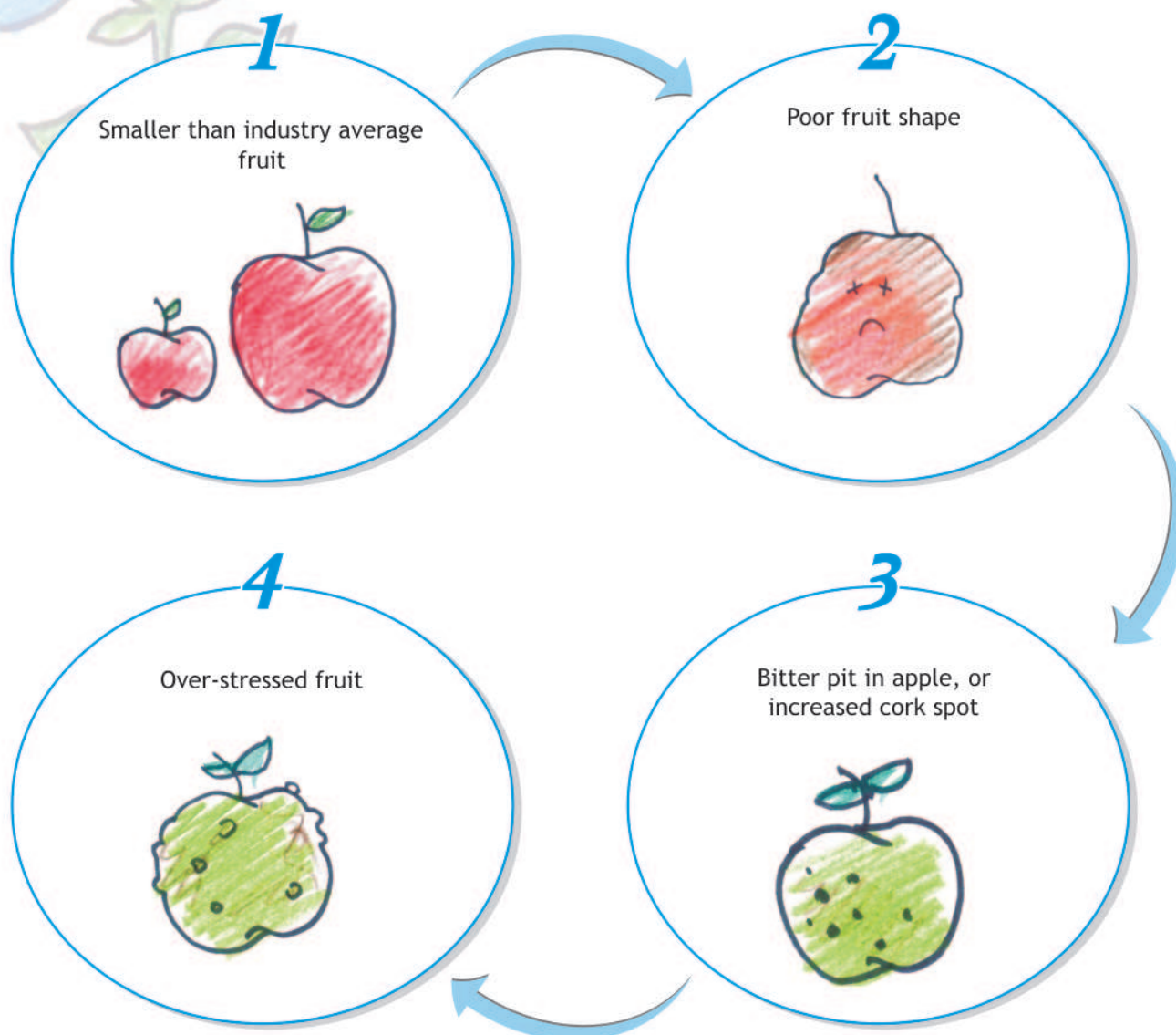


B - Under-watering

### A - Drawbacks of Over-watering

 <p>Unwanted weeds between plants</p>	 <p>Waste of valuable water</p>
 <p>Pesticides, pathogens and weeds</p>	 <p>Increased operational costs (labor, pumping, cost of water)</p>
 <p>Leaching of nutrients (e.g. salt, phosphorus) may lead to algal growth</p>	 <p>Downgraded product quality and reduced yield</p>
 <p>Higher operational costs less profits</p>	 <p>Plant roots can't breathe</p>
 <p>Pressure on water resources</p>	 <p>Watering traveling through soil washes and fertilizer</p>

B - Drawbacks of Under-water





## Managing Drip Irrigation System

### Water Application Characteristics



Low rates of water application



Over long periods of time



At frequent intervals



Near or directly into the root zone



At low pressure



Maintain high water content



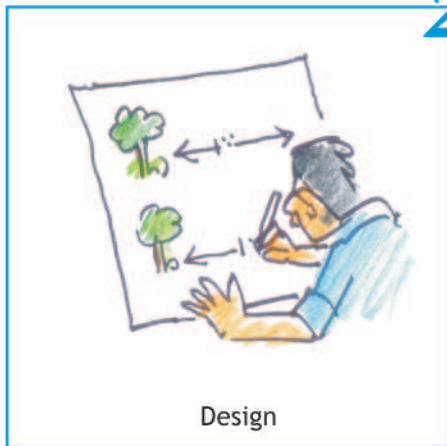
Higher value agricultural/horticultural crops and in landscapes and nurseries

## Installing an irrigation system

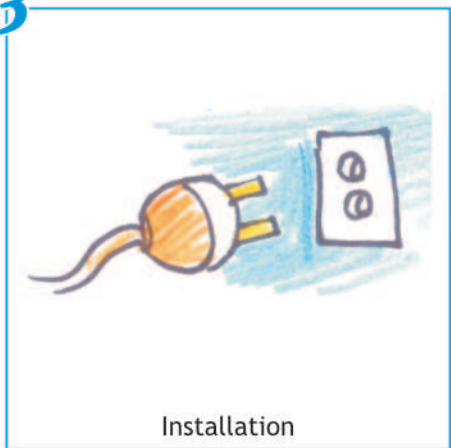
1



2



3



4






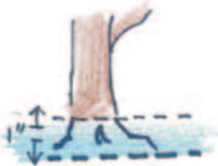




## Design and Management Issues

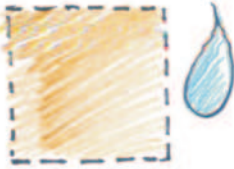
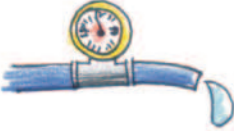

<b>Clogging</b>	<ul style="list-style-type: none"> <li>💧 Physical (mineral particles)</li> <li>💧 Chemical (precipitation)</li> <li>💧 Biological (slimes, algae, etc.)</li> </ul>
<b>Filtration</b>	<ul style="list-style-type: none"> <li>💧 Settling basins</li> <li>💧 Sand filters</li> <li>💧 Screen filters</li> </ul>
<b>Chemical treatment</b>	<ul style="list-style-type: none"> <li>💧 Acid: prevent calcium precipitation</li> <li>💧 Chlorine</li> <li>💧 Control biological activity: algae and bacterial slime</li> <li>💧 Deliberately precipitate iron</li> </ul>
<b>Flushing</b>	<ul style="list-style-type: none"> <li>💧 After installation or repairs, and as part of routine maintenance</li> <li>💧 Valves or other openings at the end of all pipes, including laterals</li> </ul>
<b>Application uniformity</b>	<ul style="list-style-type: none"> <li>💧 Manufacturing variation</li> <li>💧 Pressure variations in the mainlines and laterals</li> <li>💧 Pressure-discharge relationships of the applicators</li> </ul>



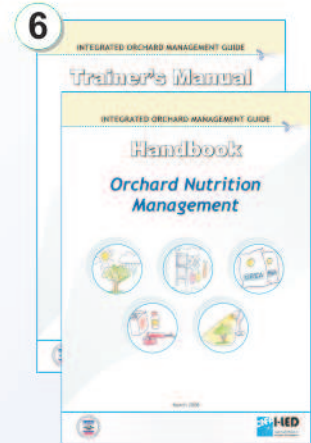
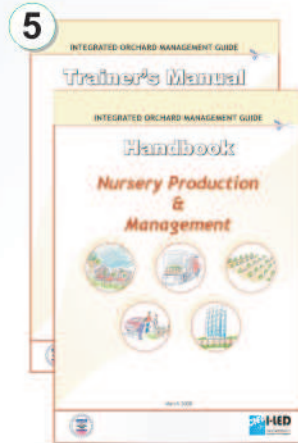
## Orchard Irrigation Tips

1		<p>Dry soil stresses plants by tying up nutrients, killing delicate root tips and depleting water from the plants</p>
2		<p>Light watering on dry soil encourages shallow root development</p>
3		<p>Soggy soil drowns or suffocates the plant, kills root tips, and encourages root rots.</p>
4		<p>One inch of water per week is the amount needed for plants to remain healthy in most soils</p>
5		<p>It takes 27,000 gallons of water to equal one inch application</p>
6		<p>One inch over 100 square feet equals 60 gallons</p>



7	 An illustration showing a square area with a dashed border and a water droplet to its right.	Estimating Square Footage to meet Plant Water Needs (100 sq. ft. equals 60 gallons)
8	 An illustration of a blue pipe with a yellow water meter.	Calculate Water Delivery
9	 An illustration of a small green plant with a water droplet falling from its leaves.	Available water to plants is more crucial at certain stages of development.

# INTEGRATED ORCHARD MANAGEMENT GUIDE



ECI (Pvt.) Ltd.  
Plot 11-13, Raja Iftikhar Sabri Street, Phulgran Road,  
Bahara Kahu, Islamabad, Pakistan.  
Ph: +92-51-2230895-97  
[www.eci.com.pk](http://www.eci.com.pk), [info@eci.com.pk](mailto:info@eci.com.pk)