CHAPTER 7

Water Management in Horticultural Crops

OBJECTIVES

After studying this chapter, students will be able to:

- Learn about water management and various methods of irrigation including micro irrigation techniques
- Select the suitable irrigation system for different horticultural crops.
- Manage the horticultural crops by making efficient uses of available water resources.
- Decide on the most appropriate irrigation system for a given situation.

INTRODUCTION

Horticultural crops require significant amounts of water due to their perishable nature. In fruit trees, water stress not only affects the current season's crop, but future crops as well due to their perennial nature. Since water is such a critical component of the growth and development of horticultural crops, it is recommended that none of these crops be established without assured irrigation facilities. Water requirement of a plant depends on its growth habit and life period. Plants differ greatly in their water requirements. Now, certain questions may arise in your mind. Is there a choice to practice particular method of irrigation? What is the most economic method of irrigation? This chapter will cover the basic information regarding various irrigation systems used in horticultural crops.

Water Requirement:

Water requirement of a crop is the quantity of water needed for normal growth, development and yield and may be supplied by precipitation or by irrigation or by both. Water is needed mainly to meet the demands of evaporation (E), transpiration (T) and metabolic needs of the plants. The water requirement of any crop is dependent upon the following factors:

- Crop factors like variety, growth stage, duration, plant population and growing season.
- Soil factors like texture, structure, depth and topography.
- Climatic factors like temperature, relative humidity and wind velocity.
- Crop management practices like tillage, fertilization, weeding etc.

Irrigation Systems:

Irrigation may be defined as artificial supply of water to support plant growth and production in the absence of adequate supply of water through rainfall. Water is the main constituent of plants. It performs the following important functions in plants:

- Water is essential for the germination of seeds and growth of plants.
- During the process of photosynthesis, plants synthesize carbohydrates from carbon dioxide and water. Therefore, water is one of the essential components for the plant.
- Water acts as a solvent for fertilizers and other minerals, which are taken up by the plant roots in the form of solution. Thus, water serves as the medium in which plants absorb soluble nutrients from the soil.
- Water serves as medium for transport of chemicals to and from cells.
- Water pressure in plant cells provides the firmness to the plants.

Irrigation is very important in horticultural crops as sufficient moisture must be maintained in the soil for obtaining the optimum yield of quality fruits. The aim of irrigating the crops should be to wet the entire root zone without allowing any wastage of water beyond the root zone. The irrigation system has to be properly devised so that the water requirements of the crops are met at the minimum expenditure without any wastage of water. Various types of irrigation techniques differ in how the water obtained from the source is distributed within the field. In general, the goal is to supply the entire field uniformly with water, so that each plant has the amount of water it needs, neither too much nor too little.

Many factors determine the suitability of irrigation system for a particular crop. Several methods are employed for the irrigation of horticultural crops depending on the type of crops grown whether fruit plants or vegetables or flowers or plantation crops, age of the tree, the soil topography and the availability of irrigation water. Thus the system of irrigation must be decided in relation to the varying field conditions. Choose the correct system for a particular crop and situation.

Irrigation is generally applied to horticultural crops by flooding on the field surface (Surface irrigation), applying beneath the soil surface (sub surface irrigation), spraying under pressure (sprinkler irrigation) or by applying in drops in the crop root zone (Drip irrigation). Several water application methods are practiced to suit different soil types, the topography of the land, crops to be irrigated and costs. Different systems of irrigation commonly adopted in horticultural crops are as follows:

A. Surface irrigation: In this method, water is applied to the crop by flooding it on the soil surface. In this system whole of the area is irrigated through one head i.e. without sub-division of the unit area into small plots. Irrigation water used in this case is excessive as the entire field is to be wetted to meet the need of the excessive root system. It provides fully saturation of root zone. In this system, the wastage of water is more and this also leads to excessive weed growth. This method is simple in layout and operation. More than 90 % of irrigated area in India is under surface irrigation. This method may be classified as border, furrow and basin.

1. **Border method:** In this method, border are formed by making number of strips which are separated by ridges. An irrigation channel runs along the upper end of the borders.

2. **Furrow system:** This system is suitable in areas where the orchards are planted in sloppy land. In this system the water moves slowly in furrows in the area between tree rows. The trees are fed through the lateral movement of water. The consumption of water is less in this system and there is no risk of bark diseases. Saturation of root zone is comparatively less. Intercropping or green manuring is not possible in furrow system. This system is suitable for old orchard.

3. **Basin system:** In this method, a small circular basin is provided around the tree trunk. These basins are linked directly with one another through straight channel. There is less wastage of water and it checks weed growth. Water passing through the channel touches the tree trunk directly and hence risk of bark diseases is involved. The water flow also draws away the manure from the tree basins and deposits it at the end of the channel. This system is suitable for young fruit plants below 1- 2 years of age. This system is useful for loamy soils.

4. **Modified basin system:** This system is an improvement over the basin system. In this system, main channel runs in between the tree lines and the basins are linked with it independently through small sub-channels. The only drawback of this system is that this needs more attention to block the sub channels after the basin has received adequate water. The size of the basin is increased with the extension of the leaf drip of each tree every year. Intercropping is not possible in this system. This is a good system of irrigation for the young orchard upto 6-8 years of age and also for the arid- irrigated areas where there is a shortage of water.

In improved modified basin system, the basins are linked with the channel passing through along the side of these basins. This system avoids the risk of bark diseases and intercropping is possible.

B. Sub-surface irrigation: In this system, perforated or porous pipes are laid out underground below the root zone and water is led into the pipes by suitable means. In either case, the idea is to raise the water by capillary movement.

C. Sprinkler system: This system is used where water supply is not adequate. The water is pumped with pressure through the sprinklers attached to pipes and these sprinklers are adjusted in such a manner to overlap upto one fourth area covered by the other sprinklers. These are then moved to the next point after sufficient percolation hastaken place. This system is very costly and is suitable in areas where the sub surface water is not fit and the soil is uneven or sloppy and the water supply is not regular from the canals. There is considerable saving in water used through sprinkler irrigation than surface irrigation. The initial, operational and maintenance costs are high. It is suitable for the full grown orchards and vegetable crops.

D. Drip system: This is system of irrigation which supplies water to the plant equivalent to its consumptive use. This is highly water use efficient system of irrigation. The water is supplied with pressure after filtering it through the pipes with attached drippers designed to supply water in drops. These drippers are placed around the plant in a circular pattern and the percolating water moves down and side ways wetting the root zone. This system requires regular water supply. Advantages of drip irrigation system are:

- Wastage of water through percolation, seepage and evaporation is checked as the water is carried through main lines and laterals. There is 30-70% saving of water.
- Uniform distribution of water
- The labour requirement is minimized considerably.
- Easily adaptable in hilly and undulating lands
- Reduced weed problem.
- Lower quality water of water can be used.
- Increased plant growth and yield.
- Ideal for poor soils and provides better root system to the trees.
- Works at low pressure
- Can irrigate at any time of the day.

- Causes no erosion
- Application of fertilizer can be done.
- Less incidence of diseases

Disadvantages:

- Clogging of drippers due to oxidants and algae
- High initial investment

Fertigation: It is the application of fertilizer or chemicals through the irrigation system. It is a controlled system to supply soluble plant nutrients at the root zone of the irrigated crops. Fertigation is done through tank, ventury or pump systems. The most practical method of applying of fertilizers through the irrigation system is by creating a 10% bypass flow of the main line flow, through an artificial fertilizer mixing tank.

Advantages of fertigation:

1. An opportunity for placement of fertilizer at the vicinity of root zone of the crop along with irrigation water which increases in water and fertilizer use efficiency.
2. Deeper penetration into the soil.
3. Avoids is volatilization from soil surface.
4. Easy coordination with specific crop demand.
5. Decrease in labour and energy cost in fertilizer application by making use of waterdistribution system.
6. Improves the availability of nutrients and their uptake by roots.
7. Trace elements can also be applied along with major nutrients.
8. Saving of fertilizers.

Fertigation Tank Fertilizer injector

Limitations of fertigation:

1. Possibility of clogging emitters if the pH of irrigation water and fertilizer sources is not managed carefully.
2. May result in possible contamination of the drinking water supply if devices are not usedto prevent back flow of nutrients into the well or other water sources.
3. Some of the chemicals are quite corrosive to metal and also cause skin burning is safety devices are not provided to protect the workers against unplanned discharge or spilling of chemicals.

Irrigation Scheduling:

When to irrigate and how much to irrigate, form the schedule of irrigation. In order to avoid water stress in plants and to obtain good yields of quality fruits, proper irrigation schedule should be followed. Scheduling of irrigation in plants is governed by soil, climatic and plant factors. Some practical approaches used to determine schedule of irrigation are soil moisture depletion, cumulative pan evaporation and sensational etc.

Critical Period for Irrigation:

Assured supply of water is required at certain stages of plant growth, which are referred to as critical period for crops. If water is not available at critical stages, yield is greatly reduced. For herbaceous crops, germination is critical stage. Depending upon the crop, critical stages vary such as head development for cole crops, pod development for beans, tuberizationfro potato, bulb development for onion and garlic, flower development for flower crops, fruit setting and development for fruit crops.

ACTIVITY/EXERCISE

1. Visit any orchard/vegetable farm of your locality and find out, which system of irrigation is practiced, predominantly.
2. Prepare a plan for model unit of drip irrigation system along with fertigation unit for one hectare farm area.

CHECK YOUR PROGRESS

1) Define irrigation? Write the important functions of water in plants.
2) Enlist the various systems of irrigation. Discuss the most useful system suitable for areas with water scarcity.
3) Differentiate between flood and furrow systems of irrigation?

FILL IN THE BLANKS

1. Water requirement of a plant depends on its……..and ……..
2. Water serves as the medium in which plants absorb……..from the soil.
3. In ……..system of irrigation, the wastage of water is more and this also leads to excessive weed growth.
4. …….system of irrigation is suitable for young fruit plants below 1- 2 years of age.
5. Application of liquid fertilizer to the root system is possible through…….. system of irrigation

SUGGESTED FURTHER READINGS

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