Chapter 5: Irrigating your water-conserving garden

Topics to be covered in this chapter

I. How much water does a plant need?
II. Types of irrigation systems
III. General considerations for the creation of an effective irrigation system

Definitions

Drip irrigation: a method of watering landscapes in which water is released evenly and slowly through emitters at a constant and specific rate.
Drip line: the line beyond the outer edge of the plant's foliage.
Emitter: a device used in a drip irrigation system to deliver water to a plant's root zone at a constant and specific rate, and at a low volume and pressure.
Establishment period: the length of time needed for plants to clearly show root and foliage growth.
Leaching: the movement of soluble salts or contaminants in the soil below the root zone.
Spray irrigation: a method of watering landscapes using a mechanical device that releases water into the air in a series of droplets approximating rainfall.
Transpiration: loss of moisture from plants through leaves and other parts of the plant.

Introduction

Efficient irrigation practices will provide plants with their water needs without waste. There are many types of irrigation systems that differ greatly in their performance, efficiency, and cost. Properly designed and well-maintained systems save water and promote healthy plant growth. Using a combination of irrigation systems often provides better results than depending on one system.

I. How much water does a plant need?

An irrigation system should provide plants with their water needs, but not more. Yet, it is difficult to accurately calculate the water needs of a given plant, as they are determined by a number of factors that include the following:

1. Climatic factors: part of the water given to a plant is lost to evaporation, and therefore does not reach the plant. The rate of this evaporation is affected by a host of factors, including sun exposure, temperature, humidity, and wind speed.

2. Microclimatic factors: a plant's water needs are also determined by its location. For instance, plants located along southern and western exposures need more water than ones located along eastern exposures; and plants located along northern exposures generally need the least amounts of water. Also, plants located in shady and protected areas usually need less water than those located in the sun or those plants that are exposed to winds.

3. The stage of growth: a young plant will require more frequent irrigation. As the plant matures, it will require more widely spaced but deeper irrigation.

4. The depth of the root system: drought tolerant plants usually have deeper root systems than have water-consuming plants. Also, trees have deeper root systems than shrubs, and shrubs have deeper root systems than have groundcovers.

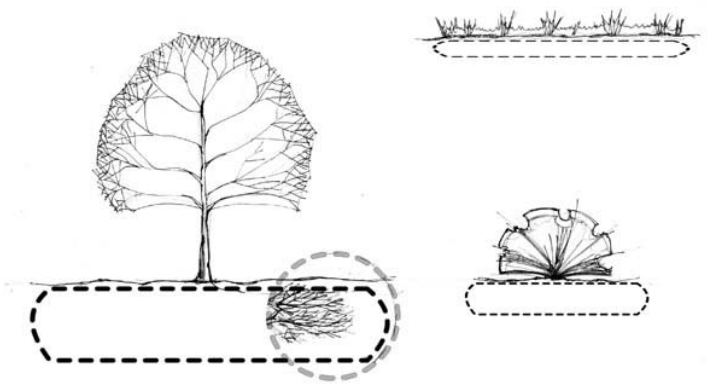

Fig. 5.1: The depth of the root system for trees, shrubs, and ground covers defines the area in the soil from which the plant can draw moisture.

5. Soil composition: soils differ greatly in their ability to store water. Soils that include a mixture of topsoil and organic fertilizers retain moisture well and also provide plants with their nutritional needs. Note that most agricultural soils in Jordan are clay loam and have a higher water holding capacity than have sandy soils. Adding organic materials to your soil mix will further increase its water holding capacity.

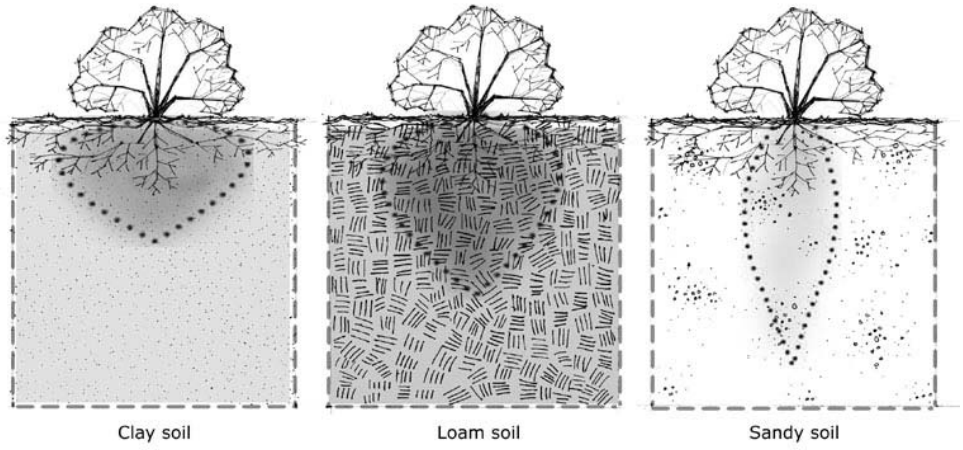

Fig. 5.2: Soil composition determines the soil's ability to store water.

Tips

A good way to identify the rooting depth for a given plant and the moisture of its soil is through using a soil probe or screwdriver. Insert it into the soil after irrigation, and push it until it hits dry soil and stops. This will give you an indication as to how deeply your plants are being watered.

6. Maintenance procedures such as fertilizing and pruning: providing proper maintenance for plants and the soil will result in savings in the amount of water that the plants consume. For more details about maintenance practices refer to chapter 7.

How much water do drought tolerant plants usually need?

Trees need supplemental irrigation to get established, especially if planted after the rainy season: During the first year, a tree needs to be irrigated in the amount of 20 - 25 liters of water two times a week. During its second year, it needs to be irrigated in the amount of 40 liters once a week. Beginning with the third year, when trees usually get established, some trees need to be irrigated in the amount of 50 - 60 liters once a month (e.g. Pomegranates), and some do not require any supplemental irrigation (e.g. Cypresses). Usually, native trees (e.g. Carob) do not need supplemental irrigation. On the other hand, trees with flowers or crops need supplemental irrigation after their establishment to achieve optimal results.

Ornamentals should be irrigated during their establishment period, which may extend to two or three years. After establishment, some require no irrigation (e.g. Agave), and others require irrigation once every week, two weeks, or every month.

II. Types of irrigation systems

1. Hand watering:

- Requires time and effort, but is very simple to use. Needs no maintenance and its initial cost simply consists of the price of the water container.
- Is specially suited for newly planted ornamentals and for selected plants that show signs of stress during the dry season.

Water saving tips for hand watering:

- Build a shallow basin just outside the drip line and apply water slowly in the basin.
- If runoff occurs before the full required amount of water is applied, move on to another spot and come back after the water has soaked in.

Fig. 5.3: Build a basin just outside the plant's drip line, where most of the feeder roots are concentrated.

2. Flood irrigation:

- Provides a continuous layer of water over a fairly level surface of soil. Water is usually applied by using a hose.
- Is easy to implement, and is considered to be the oldest irrigation method, since it is similar in principle to the way in which rain irrigates plants.
- Requires time and effort, but not regular maintenance or high initial cost, because it is manually operated.
- Does not promote healthy plant growth. The excessive amounts of water provided to plants lead to weed growth and to pest problems. Also, flood irrigation might give plants more water than they need and at a faster rate than their ability to absorb it. This results in reducing the drought tolerance of plants.
- Much of the water provided might be lost through evaporation, runoff, or wind distortion.

Fig. 5.4: Irrigation with a hose is the least efficient watering method.

Water saving tips for flood irrigation:
- Flatten the irrigated area and create a ditch around each plant to minimize water runoff.
- To avoid runoff when using a hand-held hose, use a nozzle that divides the spray into rain-size drops. Some nozzles have a built-in spray pattern adjustment.

3. Spray Irrigation:

- Spray irrigation systems range from a single sprinkler attached to a garden hose to a complex system of underground pipes and pop-up spray heads. The latter is more expensive, but more convenient and efficient.
- Does not require much time and effort, but more complex spray systems require constant maintenance and have a relatively high initial cost.
- Applies water uniformly over the desired area with a minimum of over-spray into adjacent areas. It is suitable for irrigating areas of various shapes, whether rectangular or circular.
- Does not encourage the growth of deep root systems, because it wets the soil for continuous periods of time. Consequently, limit its use to plants that have shallow root systems, such as grass.
- Up to a third of the water provided might be lost before it reaches the plant due to wind distortion or evaporation.
- Many types of sprinklers are available. Some are designed for lawns, others for beds of taller plants. Some sprinkler heads are designed for watering irregularly shaped areas.

Water saving tips for spray irrigation:
- Space sprinklers at intervals of about 50% to 60% of their wetting diameter.
- Place the nozzles as close as possible to ground level.
- Place part-circle sprinklers along the boundaries of the irrigated area to avoid over-spray onto buildings and paved areas.
- Make sure that each sprinkler head has the ability to spray free of obstructions, such as trees or tall plants.
- Use an irrigation time clock to control the irrigation program.
- Check lines and faucets for leaks.
- Regularly check sprinkler heads and unclog ones that have distorted patterns.

Measuring water output

You can determine how much water your sprinkler system puts out, by placing identical containers out on your lawn in random positions. Run the system for 15 minutes. Measure the amount of water in each container with a ruler and average the amounts. The containers that only collect 20% or less of the average indicate performance problems, and the sprinkler heads watering these areas need to be relocated.

4. Drip Irrigation:

- Consists of a system of main PVC (polyvinyl chloride) or polyethylene lines carrying water from the water source to specific plants through emitters.
- Is appropriate for irrigating all landscape areas, except for lawns.
- Does not require much time and effort, but requires constant maintenance and a relatively high initial cost.
- Promotes healthy plant growth, controls weed growth, and reduces pest problems, because of the precise water placement that it provides. The slow rate of water output gives the plants adequate time to absorb the water. Drip irrigation also wets a deeper, larger soil area in comparison to other irrigation systems, and thus encourages larger, more drought tolerant root systems.
- Uses 30% to 50% less water than spray systems. This is because very little water is lost to runoff, evaporation, or wind distortion. Consequently, it is most suitable for irrigation in arid areas, as well as in areas characterized by high winds or strong slopes.
- Is flexible. The number and location of emitters on the irrigation pipes, as well as the rate of water output, can be adjusted whenever the need arises.
- It is very easy to retrofit an existing landscape with a drip irrigation system.
- Drip irrigation lines may be placed above the ground, or they can be buried under the soil or mulch, near the plants' root systems to improve appearance and to protect them against sunlight. Placing pipes at a depth of 5 cm below ground will hide the pipes and still show a wet spot on the surface for inspection.
- Emitters can be placed along the irrigation line, wherever water outlets are desired.

Water saving tips for drip irrigation:
- Use a filter to prevent dirt and debris from clogging the emitters. This filter should be placed in the main line before water reaches any of the emitters.
- Place emitters immediately beyond the drip line of the trees to encourage them to expand their roots.
- Consider using a timer to better control the irrigation program.
- Make sure to keep dirt out of the tubing during assembly.

Fig. 5.5: Drip irrigation is the most efficient watering method.

III. General considerations for creating an effective irrigation system

- Place plants with similar water requirements close to each other, so as to irrigate them using the same irrigation line.

- Develop a schedule that trains your plants to consume less water and thus increase their overall drought tolerance. This can be achieved by watering at widely spaced intervals, but with deep applications, so as to encourage root systems to extend deeper into the soil in search of water.

Why should deep root growth be encouraged?

- Deep roots have access to additional sources of water in the soil.
- They are better insulated against extreme temperature swings.
- They provide better anchoring against the wind.

- While trees require generous amounts of water at widely spaced time intervals, plants with shallow root systems such as groundcovers, should be irrigated with smaller amounts of water, at more tightly spaced time intervals. When irrigating, water should reach a soil depth of 50 - 60 cm for trees, 35 - 40 cm for shrubs, and 15 cm for ground covers.

- Irrigate in the early morning when temperatures are lowest and evaporation is minimized.

- Modify your irrigation schedule as the seasons change and your plants grow. During the rainy season for instance, irrigation can be decreased considerably, if not stopped altogether. Also, keep in mind that drought tolerant plants need less water as they mature.

- Leach the soil during the dry season on a monthly basis by doubling up on the irrigation time, in order to carry the salts away from the root zone.

- Apply water more slowly at slopes to allow for better penetration. In general, do not apply water faster than the soil's ability to absorb it.

- Consider the use of moisture-retaining materials to minimize the need for irrigation. These can be placed either on top of the soil or mixed in it. One such material is pumice stone.

Jordan overview

Pumice stone is extracted in Jordan, where it is known as "touf" stone, and can be obtained in various sizes and colors. It contains cavities that hold moisture and also provide breathing space for the soil. Using pumice stone on top of the soil not only saves water, but also can provide an aesthetically pleasing groundcover.

Fig. 5.6: Pumice stone mulch serves to reduce evaporation.

- Carry out a soil test to determine the soil's chemical make-up and moisture-holding ability.

- Select the appropriate irrigation system for the different plants and for the different water-use zones in your landscape. Trees and shrubs in the low water-use area might need supplemental irrigation only during the establishment period. Plants in the moderate water-use zone might require water during periods of limited or no rainfall. Therefore, hand watering might be sufficient for these areas. On the other hand, high water use-zones that require frequent watering may warrant a drip irrigation system.

- Select quality equipment. Spending a little money up-front will save time and money later.