WATER MANAGEMENT

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Manual for Certified Nursery and Landscape Professionals
Original Author: Bert T. Swanson
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Nick Engler, Billie Gray, Alice Janke, Mary Keck

Approximately three-fourths of the earth's land is arid or semiarid. Arid lands receive less than 10 inches of precipitation per year and semiarid lands receive less than 20 inches per year. However, any given year may result in the receipt of considerably less precipitation than the stated averages. Since the need for water is absolute and since water is probably the most critical factor in the survival and distribution of plants, irrigation is required for all landscape plants that do not receive reliable or sufficient rainfall. Agriculture is the largest single consumer of water in the United States, using 100 billion gallons per day solely for irrigation.

Montana and Idaho receive a wide range of annual precipitation, from less than 10" per year in some areas to more than 80" per year in the mountains.

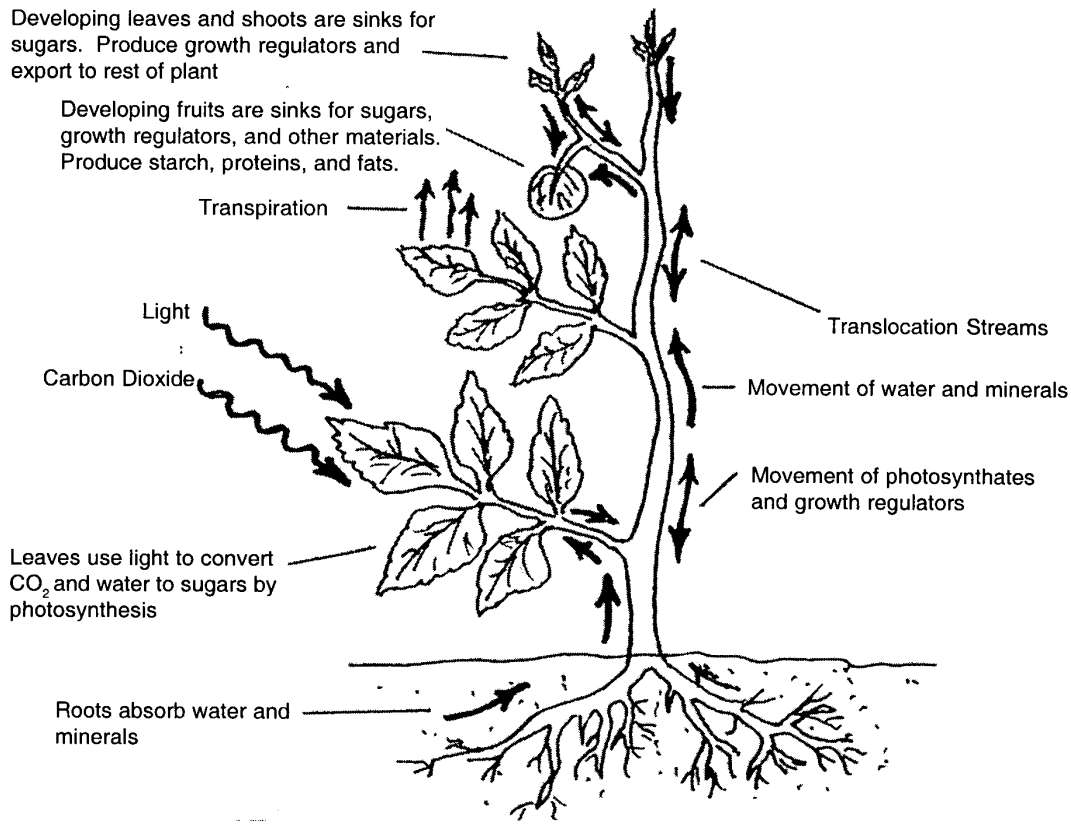
An understanding of how plants take up water from the soil is important in understanding and designing irrigation systems. Figures 4-1 and 4-2 illustrate the water uptake process. Study these figures. Water is the largest component of a plant. Water is continually absorbed by plant roots, translocated up the stems to the leaves and then lost to the air through transpiration. Photosynthesis is the process by which plants form carbohydrates from carbon dioxide and water through sunlight acting upon chlorophyll.

The lack of sufficient water for plant growth is devastating. Over-watering is just as detrimental and perhaps even more devastating. Injury from water deficiency is usually readily apparent and often easily corrected. Injury from over-watering is less easily detected and may result in severe injury or death of the root system before corrective action can be taken.

Three basic techniques exist for routinely supplying water to plants. The simplest is the furrow or flood technique in which water is carried in pipes or ditches and transferred to furrows between rows of plants or in which the water simply floods the field. This is a very inefficient system for water utilization as more than fifty percent of the water is lost by percolation and evaporation. It is also restricted to fairly level areas. However, such a system is not expensive to construct.

The second and most common irrigation technique is the sprinkler system. Such a system can vary from a single lawn sprinkler to a highly mechanized center pivot irrigation system. This system is slightly more efficient than the furrow/flood system, however evaporation losses remain high. Initial set up and maintenance costs are substantial. Aluminum pipes with impact sprinkler heads are most common in the nursery. Rigid PVC or black polyethylene pipes with pop-up or bubbler heads are most common in the landscape industry.

Figure 4-1. Water Uptake and Translocation

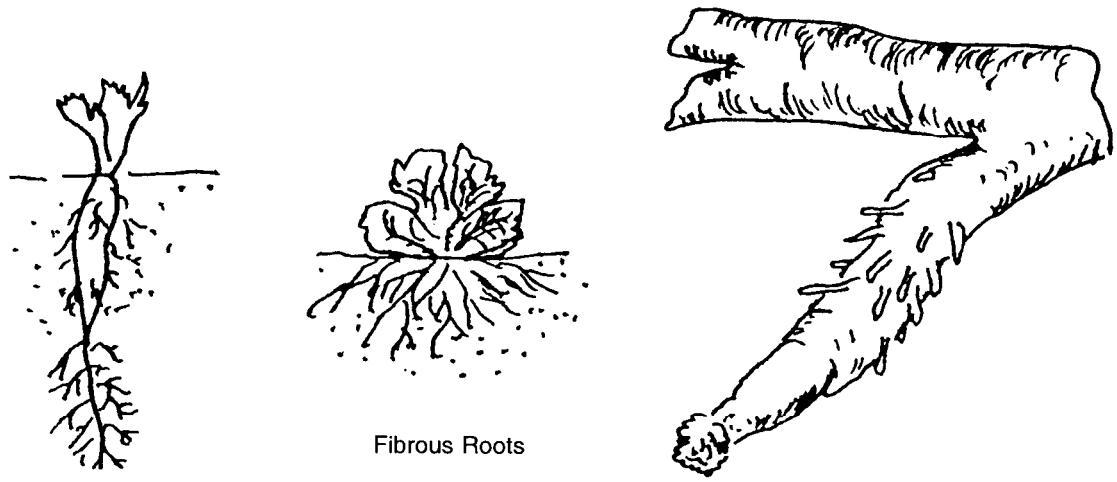


The third and most efficient technique in terms of water usage is the trickle or drip irrigation system. This system and its operation are designed to prevent water stress rather than correct it as is done with the furrow/flood and sprinkler irrigation systems. Water is provided at slow and steady rates (0.5 to 2 gallons/hour) under low operating pressure. It is directed only to the root system or part of the root system. Emitters or microtubes deliver the water to the base of each plant. Low-pressure black polyethylene pipe can be used. A pressure regulator and a water filter may be necessary. Costs for this system are moderate depending on the type of emitter used and the need for filtration.

Salt build-up can occur in the soil due to the low volume of water used. Turning the system on during a rain will facilitate leaching the salts out of the soil.

Many advantages of the system exist: it is easy and economical to install; water is applied only to the targeted plant thereby resulting in fewer weeds, less interference with sales and cultural practices, and lower incidence of disease; it is easily mechanized; and it promotes better plant growth. One disadvantage of drip irrigation is that the wet zone produced is small and can lead to restricted development of the root system in trees and shrubs.

Figure 4-2. Typical root systems



Soaker hoses are another method of drip irrigation. Water slowly seeps through the hose along its entire length. Soaker hoses are particularly useful for rows of plants such as a hedge or in a garden. They may also be used to extend the wet zone around newly planted trees and shrubs. In addition, soaker hoses can be used to add irrigation to shrub beds where the plants have grown and are blocking the existing sprinkler system from reaching the back of the bed.

A fairly recent variation on the drip system consists of large donut-shaped bladders or tubs, which can be placed over the root zone of newly planted trees and shrubs. Emitters built into the bottom of the device slowly release a given quantity of water over a period of several hours. The tubs can either be filled from a hose irrigation system or from a tank truck. Once the plants are established the tubs can be removed.

The frequency of application and the amount of water to supply depends upon many factors: species, root depth, evapotranspiration rate, soil or media characteristics, relative humidity, temperature, wind, presence of a mulch or cover crop, state of plant development, exposure, container construction, container size, container spacing, plant size, and type of irrigation system. For field soils, the procedure of forming a ball of soil (described in Table 4-1) is helpful in determining the soil moisture level. Container media must be checked by feel or by weight of the container. Both field and container stock can be monitored for moisture stress by observing a few key indicator plants. Forsythia, Cornus, and Hydrangea are extremely sensitive to moisture stress and can serve as indicator plants. By closely observing these species, irrigation needs can be anticipated.

Standard containers should be watered until water runs out the bottom for several seconds. Bare root plants should be soaked prior to planting. Upon planting or transplanting into the field or landscape, a thorough watering is required to collapse large air spaces around the root system. Enough water should be applied to the hole before planting to penetrate the depth of the root system. This is especially important when planting into dry soil. Two or more thorough waterings are usually required immediately after planting to insure the plant is completely "watered in."

Table 4-1. **Field determination of soil moisture**: A handful of soil is squeezed with moderate pressure, the hand is opened, and the soil is shaken around in the hand. Numbers in parentheses are average percentages of available water

Moisture condition	Percentage field capacity (0.5 bar)	Sandy loam	Silty loam	Clayey loam
Dry	0-5	Powder dry (0-3%)	Crumbles (0-5%)	Dry clods (0-8%)
Low	5-15	Crumbly	Loose crumbs	Pliable, no ball
Moderate	25-50	No ball	Forms weak ball	Balls with pressure
High	75-95	Forms weak ball (10-15%)	Forms durable ball (15-20%)	Easily forms ball
Wet	Waterlogged	Free water released	Free water released	Free water released

Plants in the field or landscape have a much larger reservoir of water to use compared to containerized plants. Plants in the field or landscape generally have better drainage than containerized plants. The bottoms of containers may inhibit drainage creating over-watered and low oxygen environments for the root systems. The type of soil or media plays an extremely important role in irrigation practices.

As water evaporates from a soil or media surface, salts accumulate at the surface. The concentration of salt can be detrimental to plant growth, particularly if it is leached back into the soil or media. To prevent salt buildup from occurring, periodically apply large volumes of water to leach the salts down and out of the container or down past the root system in the soil. If the soil is heavy clay it may be impossible to correct the salt buildup, as clay soil will not leach adequately. Also if the irrigation water is alkaline the effectiveness will be reduced.

Each field and landscape watering should be thorough -- water deeply and less frequently to facilitate the movement of salts out of the root zone and encourage deeper root growth, rather than the proliferation of shallow roots from frequent shallow watering. Allow the soil to drain thoroughly between irrigations and dry slightly to facilitate the replacement of oxygen to the root system. On sandy soils, more frequent shallow watering may be necessary because of the soil's inability to hold moisture.

Containerized plants must also be watered thoroughly. Because these plants are easily stressed, water must be applied more often than for field or landscape plants. It is extremely important that you allow time for oxygen to be replaced in the media between irrigations to prevent root rot and iron chlorosis of the foliage. Be constantly alert for dry containers missed by the sprinkler or which have a plugged or moved emitter. Be alert also for areas being over-watered by overlapping sprinkler heads. Periodic hand watering may be necessary if proper sprinkler coverage is not obtained.

Automatic sprinkler systems are convenient but not fool proof. Over watering is often a problem. Systems should be turned off during rainy periods. Plants that are subjected to saturated soils for long periods of time will suffer.

The time of year also plays a role in proper irrigation practices. Demand for water will be high in the spring as new growth is expanding. Water use will be even higher during the hot summer months when transpiration may exceed the plants capability of water uptake. As fall approaches, water demand decreases facilitating proper winter hardening. Plants should not, however, be placed under water stress at this time because, if severe enough, such stress will actually decrease winter hardening and therefore increase the likelihood of winter injury. After plants have lost most of their leaves in the fall or have gone dormant a thorough watering will enhance winter survival.

Water quality may be a factor in obtaining optimum plant growth. Water high in salts can be detrimental to

root growth by increasing salt levels in the soil or media. High pH water (greater than 7.2) may also cause plant growth problems. Continuous use of alkaline water will increase the pH of the soil or media and subsequently affect the uptake of specific nutrients. Iron uptake is significantly decreased as the pH increases.

Water from water softener systems that use sodium ions (Na+) to replace the ions that cause hardness should not be used to water indoor or outdoor plants. The excess sodium could create sodic conditions in the soil, which would destroy many soil properties including raising soil pH and reducing infiltration water.

Maintenance of any irrigation system must be carefully planned and executed. Maintenance should be completed on all parts of the system before the growing season. The system must be designed and maintained to accommodate the maximum demand during the peak season under the most stressful conditions. An irrigation system in disrepair during a short hot dry period can be very costly.

Although the most direct and apparent use for an irrigation system is to provide moisture for survival and growth of nursery and landscape crops, it also has several other functions. These include: leaching of accumulated salts or over-applied fertilizers from soil or media, application of water-soluble fertilizers, frost protection, moistening soil to facilitate planting or digging operations, sealing of volatile soil fumigants, the incorporation of herbicides, and the application of pesticides and growth regulators.

The effective and efficient use of an irrigation system can increase the overall growth potential of plants to enhance the landscape and improve the management and profitability of plant production.

References

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Chapter Review

A. Draw a simple plant, showing the roots, shoot, and leaves. Show how:

1. water is taken up by the plant.
2. water is lost through <u>transpiration</u>.
3. how minerals are <u>translocated</u>.

B. What process combines water, carbon dioxide, and light energy to make sugars?

C. Why is it important to allow the soil to dry between watering?

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D. List the three basic irrigation techniques. Describe how they are used and the advantages and disadvantages of each.

1. _____

2. _____

3. _____

E. What is an indicator plant, and how is it used? _____

F. Why do salts build up on the soil surface, especially in containers?

_____

G. What can you do to prevent salt build-up?

_____

H. A customer has alkaline irrigation water (pH 8.0). She asks you if it would help the plants to install a water softener in the irrigation system. What advice would you give? Describe your reasoning.

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I. Describe a few uses for irrigation, other than to supply water to plants.

1._____

2._____

3._____

J. What recommendations would you make regarding irrigation to help ensure good winter survival?

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