MASTER GARDENER
COLORADO STATE UNIVERSITY
EXTENSION

CMG GardenNotes #144

Plant Growth Factors: Water

In Colorado, both water availability and water quality can be limiting factors for plant growth. Quality issues are generally related to excessive sodium or other soluble salts.

Available water limits the potential for many crops and garden plants in many areas of the West. In western cities, the cost of the infrastructure to supply water, overallocation of limited water resources, and increasing population drive the need for water conservation.

Water management is a topic of other Colorado Master Gardener training classes. For additional information refer to CMG GardenNotes:
#260, *Irrigation Management References and Study Questions*.
#261, *Colorado's Water Situation*.
#262, *Water Movement Through the Landscape*.
#263, *Understanding Irrigation Management Factors*.
#264, *Irrigation Equipment*.
#265, *Methods to Schedule Home Lawn Irrigation*.
#266, *Converting Inches to Minutes*.
#267, *Watering Efficiently*.
#268, *Irrigation Management Worksheet: Lawn In-Ground Sprinkler System Check-Up*.
#410, *Water-Wise Landscape Design References and Study Questions*.
#411, *Water-Wise Landscape Design: Steps*.
#412, *Water-Wise Landscape Design: Selecting Turf Options*.
#413, *Water-Wise Landscape Design: Principles of Landscape Design*.

Role of Water

Table 1. Role of Water in Plant Growth	
Role of Water in Plants	**Impact of Water Shortage**
• Required component of photosynthesis and transpiration.	• Reduced plant growth and vigor.
• Turgor pressure (pressure to inflate cells and hold plant erect).	• Wilting.
• Solvent to move minerals from the soil up to the plant. ○ NO_3^-, NH_4^+, $H_2PO_4^-$, HPO_4^{-2}, K^+, Ca^{+2}, Mg^{+2}, SO_4^{-2}, $H_2BO_3^-$, Cl^-, Co^{+2}, Cu^{+2}, Fe^{+2}, Fe^{+3}, Mn^{+2}, MoO_4^{-2}, and Zn^{+2}	• Reduced plant growth and vigor. • Nutrient deficiencies.
• Solvent to move products of photosynthesis throughout the plant, including down to the root system.	• Reduced health of roots which leads (over time) to reduced health of plant.
• Regulation of stomatal opening and closure, thus regulating transpiration and photosynthesis.	• Reduced plant growth and vigor. • Reduced cooling effect = warmer micro-climate temperatures and warmer plant tissue temperatures.
• Source of pressure to move roots through the soil.	• Reduced root growth = reduced plant growth and vigor.
• Medium for biochemical reactions.	• Reduced plant growth and vigor.

One of the most common visible symptoms of long-term drought stress is leaf scorch. Street trees are especially vulnerable to leaf scorch in the hot parts of the year. **Leaf scorch** is characterized by:

- Marginal browning (necrosis).
- Often from the top down, on southwest side, or from the side with root injury or root restrictions.

Contributing factors to leaf scorch:

- Dry or overly wet soils.
- Compacted soils.
- Limited root spread.
- Root injury.
- Structural damage to xylem tissues.
- Trunk and branch injury.
- Excessive wind and heat (hot microclimates).
- Excessive canopy growth (from heavy fertilization).

Common Causes of Water Stress

Drought

- Decreased growth.
- Small, off-colored leaves.
- Decline from top down.
- Early fall color.
- Reduced xylem growth = long-term growth reduction.
- Stress may show up five or more years later.

Waterlogged Soils

- Root activity slows or shuts down, and plants show symptoms of drought.
- Decline in root growth slows plant growth processes.
- Leaves may wilt from lack of water uptake.
- Root rots are common in some species, plants vary in their ability to tolerate “wet feet.”
- Lower, interior leaves may yellow first.

Bacterial and Fungal Infections

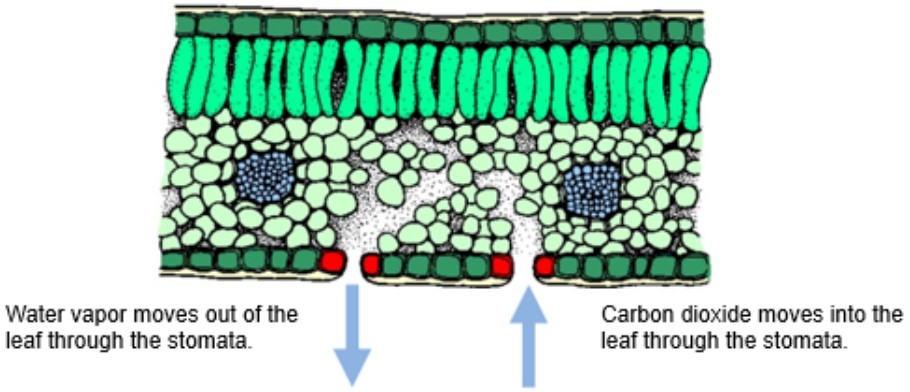
- Bacteria or fungi infect and proliferate in xylem tissue.
- Obstructed vascular system results in symptoms of drought stress.

Relative Humidity

You have already learned about osmosis and water movement. Another way to think of this is that water moves from areas of high relative humidity to areas of lower relative humidity. Inside a leaf, the relative humidity between cells approaches 100%. When the stomata open, water vapors inside the leaf rush out, forming a “bubble” of higher humidity around the stomata on the outside of the leaf.

The difference in relative humidity around the stomata and adjacent air regulates transpiration rates and pulls water up through the xylem tissues. Transpiration peaks under hot dry and/or windy conditions. When the supply of water from the roots is inadequate, the stomata close, photosynthesis shuts down, and plants can wilt. [**Figure 1**]

Figure 1. Leaf Cross Section



Colorado's typically low relative humidity means that, in general, plants not adapted to dry air are always experiencing or at the brink of experiencing stress. This is one of the reasons that it can be challenging to grow many classic garden plants without significant investment in supplemental watering and wind protection.

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