

GardenNotes #144

Plant Growth Factors: Water

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Thought question

1. Review how water stress impacts plant growth processes, then list common symptoms of drought stress.
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In Colorado, water availability and quality can be a limiting factor in plant growth. Quality issues generally deal with excessive sodium or other soluble salts.

Available water limits potential for crops and gardens in many areas of the west. In cities, the cost of the infrastructure to supply water drives the need for water conservation.

Water management is a topic of other CMG training classes. For additional information on water management, refer to CMG Irrigation Management and Water-Wise Landscape Design GardenNotes.

Role of water

Plants are over 90% water. Roles of water are summarized in the following table.

Role of water with plants	Impact of water shortage
<ul style="list-style-type: none"> • Primary component of photosynthesis and transpiration 	<ul style="list-style-type: none"> • Reduced growth and vigor
<ul style="list-style-type: none"> • Turgor pressure (pressure to inflate cells and hold plant erect) 	<ul style="list-style-type: none"> • Wilting
<ul style="list-style-type: none"> • Solvent to move minerals from the soil up to the plant <ul style="list-style-type: none"> ○ 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} 	<ul style="list-style-type: none"> • Reduced growth and plant vigor • Nutrient deficiencies
<ul style="list-style-type: none"> • Solvent to move products of photosynthesis throughout the plant, including down to the root system 	<ul style="list-style-type: none"> • Reduced health of roots which leads (over time) to reduced health of plant
<ul style="list-style-type: none"> • Regulation of stomatal opening and closure, thus regulating transpiration and photosynthesis 	<ul style="list-style-type: none"> • Reduced plant growth and vigor • Reduced cooling effect = warmer micro-climate temperatures
<ul style="list-style-type: none"> • Source of pressure to move roots through the soil 	<ul style="list-style-type: none"> • Reduced root growth = reduced plant growth and vigor
<ul style="list-style-type: none"> • Medium for biochemical reactions 	<ul style="list-style-type: none"> • Reduced plant growth and vigor

Common symptoms 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 5+ years later

Water logged 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
- Lower interior leaves may yellow

Leaf scorch (short-term water deficiency in leaves)

- Marginal burning
- Often from the top down, on southwest side, or from the side with root injury or root restrictions

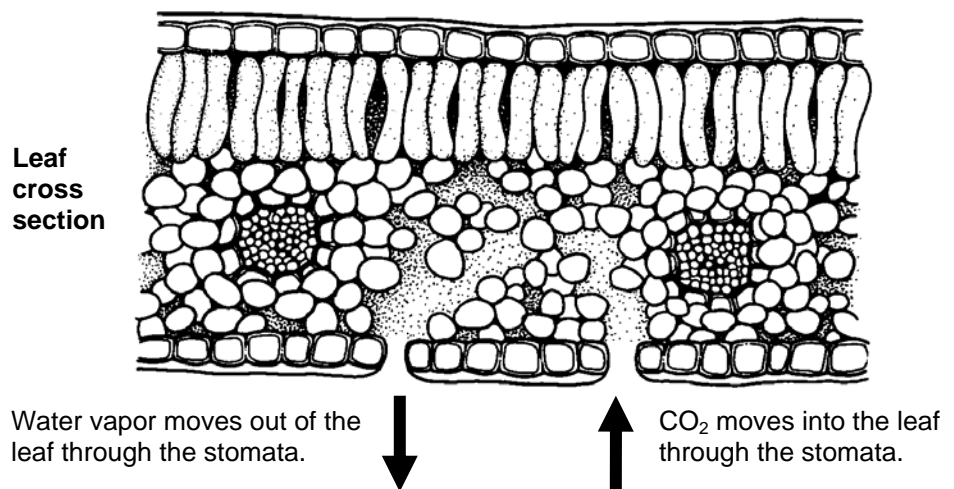
Contributing factors to leaf scorch

- 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
- Excessive canopy growth (from heavy fertilization)

Relative humidity

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.



Outdoors – In the arid climate of the west, low summer humidity helps manage some insect and disease problems and can aggravate others. The relative humidity returns to normal levels within a few minutes of watering/irrigation.

Indoors – With forced air heating, many homes have very low relative humidity in the winter. Some homes can have excessively high relative humidity due to a large number of houseplants, cooking and frequent long showers. Both extremely high and low indoor relative humidity are health concerns.

Additional Information – *CMG GardenNotes* on How Plants Grow (Botany):

#121	Horticulture Classification	#136	Plant Structures: Fruit
#122	Taxonomy	#137	Plant Structures: Seeds
#131	Plant Structures: Cells, Tissues, and Structures	#141	Plant Growth: Photosynthesis, Respiration and Transpiration
#132	Plant Structures: Roots	#142	Plant Growth: Light
#133	Plant Structures: Stems	#143	Plant Growth: Temperature
#134	Plant Structures: Leaves	#144	Plant Growth: Water
#135	Plant Structures: Flowers	#145	Plant Growth: Hormones

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