

# LANDSCAPE PLANNING

Practical Techniques for the Home Gardener

The online companion to the book

## ARTICLE

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Who would have thought that gardening required a knowledge of hydraulic engineering?

### Garden Science:

#### Plant Transpiration

**Who would have thought that gardening required a knowledge of hydraulic engineering? We might have caught a hint from the old adage, though -- Horses sweat, men perspire, women glow and plants transpire.**

Transpiration is the method by which plants circulate water from initial intake at the roots up into the leaves, where it is then vaporized and released into the air. Plants require a consistent flow of water to cool their tissues, supply nutrients for photosynthesis and move manufactured carbohydrates into storage.

The movement of moisture from roots to leaf tips takes place through an intricate network of vascular tissues similar to human veins and capillaries. Moisture is extracted from soil through the process of osmosis—from the Greek word *osmos*, meaning “a push.” Efficient osmotic pumps in the cell walls of feeder roots transport water molecules upward to stems and leaves, expanding the cells with water pressure. The drops of water that form on the stub of a cut stalk are evidence of this pressure. Fully expanded cells are turgid with positive pressure (think of celery); cells with a moisture deficit are flaccid with negative pressure (think of wilted lettuce).

Water molecules move through the plant’s vascular system from fully expanded tissues with high pressure, to flacid tissues requiring moisture renewal. Plants can react to conditions of environmental stress like intense heat or high wind by rapidly pumping water from roots into all tissues, creating sudden high pressure that threatens to burst cells. When water pressure in plant tissues is too high, excess moisture is vaporized and released through stomata, the microscopic escape valves on the undersides of leaves. The release of water vapour creates a low pressure void in leaf tissues, which in turn triggers a suction and pulling mechanism to aid osmotic pumping and get water moving upward again.

The constant push and pull of transpiration is essential to all plants. On a summer day, a mature silver maple transpires approximately 70 gallons of water an hour; a rose shrub transpires about 2 gallons a day. When rainfall and irrigation are insufficient, plants take emergency measures: stomata are tightly closed to prevent vapour loss and leaves curl inward to shade their surfaces from sunlight. Negative water pressure within cells turns leaves limp. If moisture returns, the osmotic pumps quickly restore leaf turgidity. But continued drought can check growth by inhibiting cell expansion and division. Growth may resume when water becomes available, but new leaves will be undersized and stalks shortened.

Allowing plants to wilt repeatedly causes successive growth checks, which results in an increase of abscisic acid (ABA), the stress hormone that initiates plant dormancy. Herbaceous plants stunted by excess ABA may not resume normal growth for the season. Woody plants halt twig extension and begin selective flower bud drop.

Avoid these consequences by monitoring the state of soil moisture in your garden and establishing a regular water schedule. Cover exposed soil with a three to five-inch layer of organic mulch to prevent moisture evaporation, keep plant roots cool and reduce the amount of watering necessary to prevent wilts, checks and stunts.

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