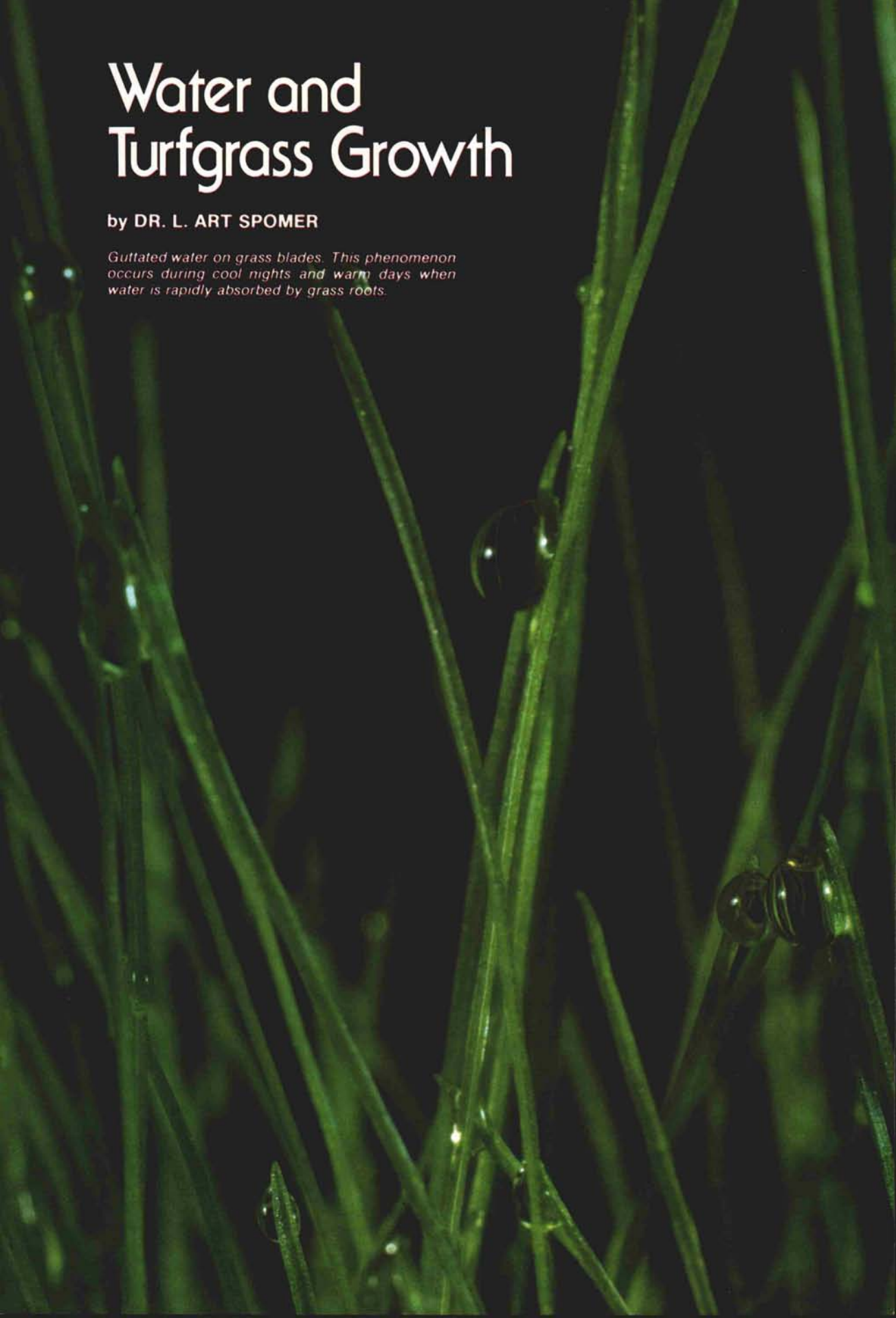
Water and Turfgrass Growth

by DR. L. ART SPOMER



Guttated water on grass blades. This phenomenon occurs during cool nights and warm days when water is rapidly absorbed by grass roots.

BOTH QUANTITATIVELY and qualitatively, water is probably the most important nutrient necessary for turfgrass growth and survival, and because of its importance, a shortage is probably the most common limiting growth factor.

Most actively growing turfgrass tissues (leaves, stems, and roots) consist of about 90 percent water by weight. This is a lot of water! To demonstrate just how much, weigh a heavy cardboard container (such as a mailing tube), cap one end, fill it with water, and reweigh it. You will find that when it is full of water, it also consists of 85 to 90 percent water by weight. So plants are literally living, growing containers of water. Even woody tissues often contain 40 to 60 percent water.

If plants really contain this much water, why isn't it readily apparent? A bluegrass plant, for example, consists of about 90 percent water, yet it has a solid appearance and feel. When it is mowed, water does not run out freely as it would from other containers. The only noticeable water is a slight moistness at the cut surfaces. Why? The plant is not a single large container; it is composed of billions of microscopic containers, called cells, cemented together to form the plant body. When a stem or leaf is cut, relatively few cells are cut open and only a little water leaks out. If all the plant's cell walls and other solids could somehow be made transparent, the plant would appear as the continuous, nearly solid body of water it actually is.

Plant water content averages about 80 or 90 percent. In general, the more actively growing the plant or plant part, the higher is its water content. Water content within a given tissue, however, can vary significantly over a short period, as evidenced by rapid wilting and recovery within a short period, sometimes within minutes.

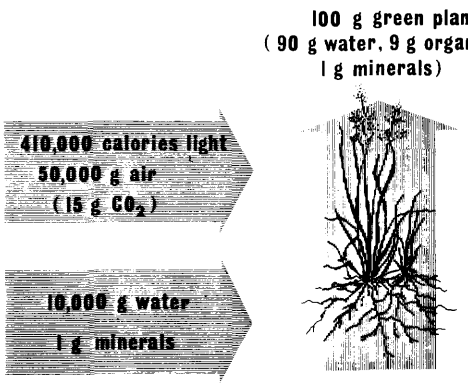
Plants not only contain tremendous quantities of water, but they often use over a hundred times as much during growth. Why is so much water necessary? This large amount of water is more than just an inert filler. Probably every plant growth function is affected directly or indirectly by water.

Water has at least four direct functions in relation to growth.

(1) Water is the hydraulic agent which maintains cells in the fully expanded or turgid condition necessary for the support of leaves and for growth of all plant parts. Water is drawn into the cells by its attraction to the salts and other materials found there. Since salts cannot readily move out of the cells, this absorbed water exerts pressure that stretches the cell walls, causing the cells to grow larger, like swelling balloons.

(2) Water is also a solvent and a transport agent in which all nutrients and plant products move into and throughout the plant.

(3) Water is the main constituent of the cell protoplasm where it is both a filler and a structural component. Most essential plant activities, including the production and utilization of "food," occur in the protoplasm. The delicate structure of the protoplasmic machinery responsible for these activities is partially maintained by the water.



Plants require and contain more water for growth than any other raw material.

(4) Water in the protoplasm also functions as a raw material in the plant's chemical processes. The most significant reaction in which water is involved is in photosynthesis, which also directly or indirectly supplies all of the food consumed by humans.

Photosynthesis, by the way, is the most efficient and most significant means available for converting solar energy into usable energy. Not only is it a source of food, but photosynthesis is also the basic process responsible for the production of all of the fossil fuels (gas, coal, petroleum).

In addition to these direct functions of water in plants, it also indirectly affects plant growth by conditioning the plant's environment and buffering the plant from rapid or extreme temperature changes. Water affects the plant's physical, chemical, and biological environment above and below ground. Water has a high heat capacity, which simply means that it exchanges large amounts of heat energy per degree temperature change. It also has a high latent heat of vaporization, meaning it absorbs a tremendous amount of heat energy upon evaporation — has a great cooling effect. Their high water content gives plants a high heat capacity, allowing it to resist rapid temperature changes, while the evaporation or transpiration of water from plant surfaces cools the plant.

What happens when plants do not get enough water? Since water is so important for plant growth, a lack of water causes stress and affects growth. A water deficit occurs whenever the plant requires more water than it absorbs. The overall effect of a water deficit is reduced growth, injury, or death.

Most turfgrass plants experience frequent or nearly continuous water deficit or stress of varying degrees during growth. This is especially true during sunny daylight hours. (Well-watered turfgrass plants usually do not experience water stress at night; the exudation or guttation of water droplets

DR. L. ART SPOMER is associate professor of plant physiology in horticulture at the University of Illinois.

at their leaf tips, which is often usually mistaken for dew, is evidence of this.) The overall effect of this prevalent water deficit depends on its severity, duration, and frequency as well as on the plant species, growth stage and culture. The first effect of a water deficit is a loss of turgidity and the plant begins to wilt. Wilting causes expansion growth to slow or stop, and usually it also reduces photosynthesis. The first and most common effect of a water deficit, therefore, is reduced plant size.

As water stress becomes more severe or prolonged, more and more plant processes are affected until the plant is permanently injured. The injury shows by browning and dieback. Most plants, however, adapt in various ways and to varying degrees to survive repeated or prolonged periods of water stress. Some will even survive water losses of 30 percent or more. Plants that are highly resistant to water stress are called xerophytes and include cacti, succulents, and sagebrush. Many turfgrasses survive severe water deficit by becoming dormant. This usually means the leaves stop growing and turn brown. Many plants survive water stress by developing more extensive root systems. Most turfgrass plants, however, are limited in this respect by their fibrous root systems, which are primarily distributed in the upper layers of soil. Most turfgrass plants are only moderately resistant to water stress, especially if we want them to remain green and playable.

On the other hand, and in some cases, moderate water stress may actually enhance plant quality by increasing the plant's resistance to further water stress. Actual effects in any specific case depend on the severity of the stress and upon the species and growing conditions before, during, and after this period of stress. In all cases, however, growth is reduced.

Turfgrass plants can also suffer from too much water, which results in a lush growth that is too soft, too succulent. Excessive soil moisture results in poor aeration. This can cause poor root growth, poor water and mineral absorption, increased disease susceptibility, and it may even kill the plant. Successful plant growth depends upon a plant's tolerance of both deficient and excess water and the ability of the turf manager to maintain the water supply within a particular plant's tolerance.

How much water is required for turfgrass growth and survival? *The Plant's Water Requirement Is The Minimum Amount of Water Required to Provide Optimal or Adequate Growth.* You can see right away that this is a somewhat nebulus concept which depends upon the species or variety, the purpose for which it is being grown, and the meteorological and other environmental conditions prevalent during growth. In general, the more water supplied to turfgrass, the more water it uses, often with no corresponding increase in growth. It is luxury consumption. Very little of this applied water is actually used for growth. Often less than one one-hundredth of the amount absorbed is actually retained by the plant for growth. The great bulk of absorbed water is evaporated or transpired into the atmosphere. Turfgrass water requirement, therefore, depends primarily upon local climatological conditions and only secondarily on variety or species.

In conclusion, water is quantitatively and qualitatively the most important nutrient required for turfgrass plant growth. Water affects every aspect of plant growth and is truly the life substance of plants. Not enough is known about turfgrass minimum water requirements to give blanket recommendations, but research is now being conducted to develop more reliable methods of determining turfgrass water requirements in order to ensure maximum irrigation efficiency.

National Golf Day

The Green Section of the United States Golf Association salutes the Professional Golfers Association for its annual contributions to turfgrass research. Through its National Golf Day Fund, the PGA has contributed over $275,000 to the USGA Green Section Research and Education Fund since 1952. The funds realized from National Golf Day have made it possible for the USGA to support a number of worthwhile golf turfgrass research projects which not only made possible work on important projects, but also helped train many of the present-day leaders in the field of turfgrass management.

Projects that have resulted from funds channeled through the USGA Green Section Research and Education Fund include studies on *Poa annua*, thatch control, the control of regular crabgrass and silver crabgrass (goosegrass), effects of 2,4-D on weeds and grasses, physical properties of putting green construction, bermudagrass selection and breeding, bentgrass selection and breeding, Kentucky bluegrass selection and improvement, selection and breeding of the fine and tall fescues, the effects of management practices on the speed of putting greens, disease, insect and weed studies, to name a few.

The Round of the Champions will be played on May 28 at the Oak Tree Country Club, in Edmond, Oklahoma. On that day Hollis Stacy, the Women's Open Champion, and Nancy Lopez-Melton, the LPGA Champion, will set the target score for women to shoot at, while Andy North, the U.S. Open Champion, and John Mahaffey, the PGA Champion, set the target score for men. Amateurs compete against the low score using full handicap.