Irrigation Water Quantity

INTRODUCTION

Water is the primary requirement for growth and survival of turfgrasses. Plants consist of cells which are containers of water. Plants maintain turgor (are rigid) when their cells are filled with water. Cells collapse when they lose water. If enough cells lose their turgidity, the leaf rolls and turns a blue-green color, while the stem droops. The plant is then considered *wilted.* Plant water content typically is between 75 to 85 percent by weight. Plants begin to die if water content drops to 60 to 65 percent within a short period of time.

Unfortunately, rainfall is not frequent enough to provide adequate water to sustain turfgrasses under today's intensive golf course management culture. This is further intensified by Florida's year-round warm subtropical weather and soils that are primarily sand. Irrigation with acceptable quality water is therefore is an important part of golf course maintenance. To ensure efficient watering, golf courses require well-designed irrigation systems that are based on soil infiltration rates, soil water holding capacity, plant water-use requirements, depth of root zone, conveyance losses from the surrounding area, and desired level of turfgrass appearance and performance.

WATER USE AND TURF STRESS

Soils contain a reservoir of water for turf plants. Water enters the plant through root hairs near the root tip and diffuses into the xylem, made up of water-conducting cells. Water then moves through the stem up into the leaves and then into the atmosphere through leaf stomates. This process is termed *transpiration.* When transpiration occurs, water is literally "pulled" up a pressure gradient from the soil through the stem and eventually up to the leaves. Generally, the gradient becomes steeper from the soil through the plant's vascular system to the leaf stomata and into the atmosphere. This gradient is termed *water potential* and is expressed in negative values. The chemical potential of water within this system is lower than that of pure free water. Water potential is generally expressed as bars or megapascals where 1 megapascal equals 10 bars. Classic soil water potentials have been defined as 0 bar when saturated, to -15 bars when soils are so dry that plants are considered to be permanently wilted. For *plant* water potential, 0 bar represents fully turgid plants and ranges to -20 bars for severely wilted ones. In the *atmosphere,* 0 bar represent water saturated air, or 100% relative humidity while, -1000 bars is a very low relative humidity (e.g., arid). Due to this gradient, water will move from a site of high-water potential (e.g., 0 bar) in soil to one of lower potential (e.g., negative value) in air.

Transpiration serves several other important functions in addition to providing water to living plant tissue. Mineral nutrients are transported through the transpiration stream. Evaporation of water from the leaf surface results in evaporative cooling, thus moderating canopy temperature. This is important for maintaining plant cell metabolism. Humans have a similar process in which perspiration evaporates and cools our bodies.

Evaporation is the flow, or loss, of water from the soil directly to the atmosphere. Collectively, *evapotranspiration (ET)* is the total water lost by encompassing transpiratory movement of water from soil, through turf, and ultimately into the atmosphere, and by evaporation that occurs from soil directly into the atmosphere. Parameters largely controlling ET are light intensity and duration, humidity, wind velocity, and temperature. Other parameters that affect ET to a lesser extent include soil-water content, turf-root system development, and turf cultural practices.

Soil-Water Relationships

Major soil water sources include precipitation, irrigation, and capillary rise of moisture from below the root zone. Capillary rise of moisture into the root zone is important in some areas of Florida where high