A view of a fairway sprinkler in operation.

A Closer Look at Watering

By **Holman M. Griffin**, Agronomist

The objective of watering turf is to maintain sufficient moisture in the soil for satisfactory growth and performance of the grass. In order to do this we must periodically replenish the moisture lost to drainage, plant use and evaporation, and maintain moisture in the full depth of the effective rooting of the grass. The big question to be answered before we can effectively cope with watering turf is:

"How much water does the turf need?"

If you can even come close to answering this question, then you truly have a green thumb as well as a keen grasp of turf problems. I hope that this review of some of the factors involved in the watering of turf will help your maintenance program and stimulate your thinking to aid you in making your decision of how much water the turf needs.

Just how water is absorbed and used by the plant is a science in itself and not all of the processes are clearly understood. However, we should be aware of the factors that influence these processes.

Water in a plant has many functions and composes 80 to 90 percent of the plant structure, so we must rightfully place great importance on the maintenance of adequate moisture for plant use.

Although this is true for all grasses, all grasses do not necessarily require the same amount of water. Considering only water requirements, we can group the grasses into three general categories: (1) Drought-tolerant, (2) Intermediate drought tolerance, and (3) Moisture-loving, with little or no drought tolerance. The more deep-rooted grasses such as Bermuda fall into the drought-tolerant class because their extensive root system is able to forage deeply for moisture. Fescue also falls into the drought-tolerant class because of its ability to curl its leaves and thereby reduce water loss from the stoma. Buffalo and bluegrass have rhizomes where some moisture is stored, which gives them moderate to good drought tolerance.

Most bluegrasses fall into the intermediate class while annual bluegrass, rough bluegrass, and creeping bent fall into the moisture-loving class because of shallow rooting or the inability to store or conserve absorbed moisture. Even though we understand these differences in drought tolerance of the grass, we must also consider such factors as soils, temperature, humidity, wind, and fertilization.

Soils greatly affect the watering program by their different capacities for moisture retention. Soils are classed roughly as clays, loams, and sands. This is the order of their ability to retain moisture. The permanent wilting percentage, or that point at which moisture is held by the soil with a force of approximately 15 atmospheres, is reached much sooner after an application of water to a sand than to a clay. Loam ranks between them.

The permanent wilting percentage of a soil is mentioned because this represents the maximum point of moisture stress to which the turf should be subjected. At this point, a plant will regain turgidity in most of its leaves when sufficient moisture is applied to the soil. Turf can survive and even absorb limited amounts of water at soil-water contents below the permanent wilting percentage. But if no water is added to the soil the turf will pass through the wilting range and quickly reach the ultimate wilting point. Then it dies.

Again considering the soils, the wilting range—from first signs of wilt to the ultimate wilting point—is narrower in coarse-textured soils than in fine-textured soils. Within this range, no plant growth occurs.

It might seem that since we should never allow the soil moisture content to reach the permanent wilting percentage that the answer to watering problems is to apply large amounts of moisture, or apply water frequently. However, this is not the case. Frequent or heavy applications of water exclude oxygen from the soil and thereby influence the rate at which moisture is absorbed by the plant. If drainage is excellent, some of the water loving types of grass, such as *Poa annua* and creeping bent, may survive on the oxygen in fresh water.

However, if drainage is poor and the water in which the oxygen has been depleted is unable to move down out of the root range to allow room for fresh water, oxygen soon becomes a limiting factor and the turf wilts.

In general though, water fills the available pore spaces in a soil and excludes oxygen in quantities sufficient for proper root functions. If insufficient oxygen is present in the root zone, this in itself causes the root cells to become less permeable to water and the moisture intake is greatly reduced. Thereby a plant may suffer from a lack of moisture even though the soil around it is saturated.

Since plants seem to absorb moisture best at or near field capacity, this is the level which we should strive to maintain. However, since water does not quickly reach equilibrium in most soils throughout even a 4-inch root zone, we are unable to maintain this level by simply watering frequently to replace the lost moisture. In the interest of good soil aeration, we should allow the soil moisture content to drop almost to the wilting range before more water is added and then the entire root zone should be recharged with fresh water. In this way the plants will always have adequate moisture and oxygen for proper growth while frequent watering would tend to exclude oxygen near the surface before the soil moisture could reach equilibrium in the root zone.

It is therefore important to observe the turf and note how long it takes the turf to begin wilting after a good watering. After observing the turf for a time and using a soil probe to check penetration and moisture depth, we can work out a pattern of watering which will supply the proper amount of moisture in the manner described previously. Although general rules about turf water requirements, such as one inch per week, are a good starting point for estimating quantities, the actual application should be more accurately determined.

Water should never be applied faster than the soil can absorb it. Otherwise we may lose a high percentage of the moisture applied through runoff and get very little penetration into the root zone of the turf.

After working out a good pattern of watering based on the characteristics of the soil we must then consider other factors, such as climate and fertilization. These will change the turf requirement.

With so many factors involved and interacting on each other, it is clear that water applications can never be reduced to a simple schedule. It must be based on the changeable needs of the grass plant to be effective.

We have often observed wilting of a green on a clear, hot, dry, or windy day. This may occur because moisture content of the soil is low. Or it may well be because the rate of transpiration of the plant is exceeding the rate of water absorption. Cloud cover, temperature, humidity and wind all have an effect on transpiration of the grass plant. As a rule, lack of cloud cover, increased temperature, low humidity and wind movement all increase transpiration of the plant as well as evaporation of water from the soil. Therefore, we must consider the influence of these factors and make adjustments for them in our watering program.

Temperature is probably the climatic factor of greatest concern, since either extreme may cause a deficiency of moisture in the plant system. At high temperatures, the rate of water loss from the plant is increased and the supply in the soil must be adequate or the plant will wilt. Quite often, golf course superintendents syringe greens in hot weather to keep them from wilting. It should be emphasized that the purpose of syringing is not to add moisture (except when extremely shallow rooting exists) but, rather, to reduce the temperature of the grass and surrounding microclimate with as little water as possible.

On the other hand, a reduction in temperature slows down transpiration and less water loss occurs from the plant. Also the viscosity of the soil water is increased and the permeability of the absorbing cells is decreased, making it more difficult for the plant to obtain the moisture it needs from the soil. When the soil is frozen, virtually no water passes from the soil into the plant.

We can now see that climate has a definite influence on the watering program and that any factor or combination of factors mentioned may change the water use of the plant.

Last, we should consider fertilization. Fertilization temporarily increases the need for water because of the action of osmotic pressures on the plant when the soil solution becomes more concentrated with solutes. Since osmotic pressures seek to equalize the concentration of solutions on both sides of a semi-permeable membrane, which is in this case the cell walls of the roots, and the movement of water is from the lower concentration to the higher one, then the addition of fertilizer may initially decrease the plant's absorption of water. It does this by increasing the concentration of solutes in the soil solution to a point greater than the concentration of solutes in the plant fluids or cell sap.

Provided the rate of fertilizer application is not too high, the plant usually adjusts to this situation very quickly and no permanent detrimental effects take place. Because of the process just explained, we should always water-in applications of fertilizer to help make it available to the plant as well as to make sure the soil solution does not become too concentrated.

Although I have just explained how fertilizer increases the need for water in plants, this effect is temporary. In the long run, proper fertilization will greatly aid the plant in its use of water. Experimental work has proven that plants which are properly supplied with nutrients actually require less water for growth and development. The mistaken belief that water can be substituted for fertilizer is altogether too common.

I have touched on the subject of watering and water use only lightly, but I hope that these facts will help to stimulate ideas, give a better idea of the principals involved and help someone to better answer the question: "How much water does the turf need?"

Automatic Irrigation

By Robert R. DePencier, Golf Course Superintendent, Sunningdale C.C., Scarsdale, N.Y.

Our Sunningdale Country Club now boasts of a completely automatic irrigation system. This is the Superintendent's "dream system," and I feel this way even though the quick coupler system that we used prior to conversion was extremely good. The old system had a capacity discharge of 3000 gpm at 85 psi. The logical question is: "why convert when you have such a good system?"

Our reasons were: To have greater accuracy and variable control of moisture so that we can water when we need to and where we need to; to use less water and so reduce our water bill; to reduce our labor costs which annually amount to $4,500, and now there should be little or no labor involved; and most important is the fact that there is less chance for human error.

In our conversion we re-piped eight fairways, using transite. On other fairways we used the original galvanized iron pipe which was installed in 1955. We have an 8-inch main which runs about 1,000 feet then breaks off to a 6-inch line which runs about 5,000 feet to all fairways. This then breaks off to 4-inch, 3-inch, and 2-inch pipe in fairways. On tees we have galvanized pipe, 1¼-inch and 1½-inch in size, and around greens we have 1½-inch and 2-inch PVC pipe.

In converting we used approximately 300,000 feet of No. 12 and No. 14 underground wire. We installed