Factors Influencing Irrigation

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Among the factors which affect irrigation practices are type of grass, maintenance levels, climate, soil type, infiltration rate, evapotranspiration rate, wind velocity patterns, terrain, turf uses, disease factors, water supply, and labor availability.

In opening remarks, panel members discussed evapotranspiration and transpiration. Evapotranspiration is defined as being all the moisture lost from the soil into the atmosphere. This results from direct evaporation from the soil and water transpired by existing plant growth. Transpirational moisture is moisture which evaporates to the atmosphere from existing plants, primarily through leaf stomata.

Evapotranspiration rates are directly related to existing environment. Tests have shown that solar energy is the most important factor. As solar energy increases, the evapotranspiration rate increases.

Other climatic factors influencing evapotranspiration rates are air temperature, air movement, type and extent of plant cover, topography, soil type and condition, and of course the availability of moisture in the soil.

After this discussion, questions were entertained from the floor. Questions asked and comments given are as follows:

Q. What effect does free moisture have on disease activity? Can disease-causing organisms be introduced through the water supply and, if so, are they a significant factor in occurrence and severity of disease?

A. It has been demonstrated that most fungi which attack grass plants require free moisture in order to penetrate the plant. Also, fungi reduce much better in a moist environment. Therefore, free water with special emphasis on frequency of watering definitely favors parasitism.

Futher, it has been demonstrated that the majority of disease causing organisms exist in both parasitic and saprophytic stages and are known as facultative organisms. The fungi known to be most damaging to grass plants subsist in dead organic matter such as mat and thatch as well as on the live grass plant. They are constantly present and may become actively parasitic on a grass plant if the plant loses vigor.

Other environmental conditions are such as previously discussed moisture relationships directly related to the severity of parasitism. It follows then that spores or fungus parts introduced through the watering system probably would be a minor consideration in respect to the overall disease syndrome. On the other hand, if irrigation water contains ingredients such as chemical waste or salts which are toxic even to a minor degree to a grass plant, the plant may be damaged to the point that it loses disease resistance and is thus subject to attack by the constantly present fungi. Once the balance between plant resistance and susceptibility is tilted in favor of the fungus, disease conditions can reach epiphytotic proportions.

If at any time there is evidence that the supply of water is damaging to existing turf, such water should be tested immediately. Obviously, if the water is proved to be damaging, an-

other supply must be found if you expect to maintain healthy turf at all times.

Q. Is there a relationship between the amount of nutrients in the soil or soil fertility levels and water use by the plant?

A. Yes, it has been repeatedly demonstrated by plant scientists that if a soil is low in fertility, larger quantities of water are used in relation to the amount of growth.

Q. What is the water requirement of turfgrasses and does this vary according to species?

A. Panel members commented that it has been their experience that practically all types of grasses used on golf courses in the United States require approximately the same total amount of water in order to subsist and reproduce. However, larger amounts of water are needed in areas where evapotranspiration rates are high. This is true because excess water is evaporated from soil and transpiration rates are high in areas of high solar energy. As a general rule of thumb, somewhere between 1 and 1½ inches of water per week is considered adequate in the Midwest and the Northeast. In the desert Southwest, 3 inches per week is more nearly the requirement. It might be noted that experience indicates that bentgrass and *Poa annua* require more frequency of water than other types of grasses used. However, the total demand does not seem to be any greater.

Q. Is a fairway watering system necessary and desirable for the production of fine turf in the Northeast?

A. From floor and panel discussion, it was determined that in any given year there is a period when fairway turf regresses to a dormant or semi-dormant state. At this time the soil is dry and compacted. Playing conditions are not considered desirable by the majority of golfers. There is a definite tendency by present-day golfers to insist upon lush, well-turfed and "soft" fairway conditions. Also, the golfing season in the Northeast is relatively short. As a result of all this, demand for fairway watering systems by the membership is becoming ever more insistent. It would follow that a fairway watering system is necessary and desirable for the production of fine golf course turf in the Northeast. However, golfers should be made aware that not all turf problems are magically eliminated as a result of the installation of a fairway watering system. Rather, a number of problems will arise which have not been a consideration in the past. Examples are: increased weedy growth which is more difficult and expensive to control; the encroachment of *Poa annua* which is considered by most to be a "fair-weather" friend or a grass plant which tends to die-out during periods of stress; disease activity will be greatly increased (a number of golf courses with watered fairways are already following a fairway fungicide spray program); water holding areas will develop and efforts must be made to improve drainage. Often such efforts are quite expensive.

Q. What is meant by water holding capacity of a soil?

A. The water holding capacity of a soil is that amount of water held by the soil when moisture relationships are between field capacity and permanent wilting point. This amount of water will vary considerably depending upon the type of soil. The range is between 30 and 300 tons per acre

foot. The amount of available water is lesser in a sandy soil and higher in a heavier or clay type soil.

Q. What are the three classes of water in the soil?

A. The three classes of water in the soil are hygroscopic — capillary — gravitational. Hygroscopic water is tightly or chemically bound to soil particles and not usable by the grass plant. Capillary moisture is that moisture which is available to the grass plant and most used in growth. Gravitational water is excess water which drains through the soil.

Q. What are the most desirable infiltration and percolation rates in a soil to support grass?

A. A considerable amount of research is being done in this area at the present time. Data indicate that a soil which when compacted contains approximately 40% by volume of the total as air space, or voids, is the most suitable for supporting turf plants. Ideally, of the the total pore spaces in the soil, 50% should be of a capillary nature, 50% should be of a non-capillary nature. Or, when water is added, 50% will drain from the soil and 50% will remain. Thus, ½ the total void space of the soil contains air and the other half contains water, most of which is available to the grass plant. In order for this phenomenon to work properly, infiltration and percolation rates are quite high. The surface of the soil should be such that water will penetrate readily. If the percolation rate or movement of water through the soil is between ½ and 2 inches per hour, it should be possible to maintain adequate air - water relationships in the soil at all times.

Q. Does the proximity of other plants such as trees affect water—turf relationships?

A. Certainly, plants such as trees and bushes transpire large quantities of water, thus tend to dry an area. The presence and location of such plants definitely compounds and confuses watering programs. In order to develop fine turf in these locations, the golf course superintendent must plan his watering program accordingly.

In summation, it is apparent that for production of fine golf course turf, availability of adequate water is primary. However, this is an extremely complex subject and one which cannot be taken lightly. After a fairway watering system has been installed, maintenance practices become more demanding and difficult.

Fungi as Agents of Disease

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An introductory paper outlining the relation of fungi to disease in turfgrasses. The number of fungal species involved, their economic importance and distribution is discussed. The cellular and physiologic characteristics fitting these fungi to act as pathogens is considerd. Interactions between host, parasite and environment are described.

The unique cultural practices employed and their affect on the growth habit of grasses as factors favoring attack by specific fungus are pointed out. The role and nature of propagules as inoculum is surveyed.

A discussion of sympton expression resulting from fungal invasion both to individual plant parts and turf is given and the possibility of wrong diagnosis using symptoms only is noted. The subject of organic residues and additives as substrates for potential fungal parasites is discussed.