Watering Turfgrass and Disease Potential: Leaf Wetness

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Introduction:

Most fungal foliar disease pathogens require specific leaf surface conditions for their spores to germinate; favorable temperature and a film of water on the plant surface (or a high relative humidity) are required. These conditions must last sufficiently long enough for the pathogen to penetrate the plant, otherwise the germinated spore dries out and dies (Agrios, 1988. p. 45). The presence of dew on the leaf surface and extending this natural period of leaf wetness results in increased fungal growth (Smiley, et al. 1993, p. 78) and the presence of foliar diseases (Leslie, 1994, p. 389).

Dew on turf consists of condensation from the atmosphere (~75%) as well as guttation/exudation fluids from the leaves (~25%) (Williams et al., 1998). The presence of sugars, starches and amino acids in the guttation fluids exuded from the plant provides an energy source for the invasion of the plant by the pathogen.

Bacterial diseases increase in severity in direct relationship to the length of time the leaves are wet (Sirjusingh, et al. 1996; Zehr et al. 1996). Infection of turf by bacterial pathogens also increases under shade conditions due to the increase in humidity within the turf canopy and the increase in the length of time the leaves remain wet (Giesler et al., 2000). Rusts (*Puccinia* spp.), powdery mildew (*Erysiphe graminis* DC.) and leaf spot fungi (*Bipolaris* and *Drechsler* spp.) also are more severe in heavily shaded grasses than in areas with full sun exposure (Beard, 1965; Smiley et al., 1993). Beard estimated that 20 to 25% of all turfgrass is shaded to some degree by trees, shrubs, or buildings (Beard, 1973).

With fungal diseases, moisture on the foliage determines the production of spores and their survival. Gross et al., report the severity of brown patch (*Rhizoctonia solani*) increases as the length of leaf wetness increases above 9 hours. The longer the leaf surface is wet, the greater the risk of infection and the greater the number of infections per leaf. Fidanza et al., report minimal infection of this disease occurs when the duration of leaf wetness is below 6 hours with severe infections occuring when the length of leaf wetness increases to 8 to 10 hours. Irrigation in the afternoon is directly associated with an increase in infection, especially when warm day temperatures are followed by cool night temperatures (Dickson. 1930). Once the optimum temperature is reached gray leaf spot of perennial ryegrass and tall fescue (*Festuca arundinacea* Shrebl) caused by *Pyricularia grisea* (Cooke) Sacc. increases in severity with an increase in the length of leaf wetness (Uddin et al. 1997; Moss & Trevathan, 1987; Williams et al, 2001).

Even patch diseases have been reported to be more severe with prolonged periods of leaf wetness (Fidanza, et al. 1996; Giesler, et al., 1996) The take-all patch organism (*Gaeumannomyces graminis*) is particularly sensitive to moisture fluctuations and high moisture levels in the surface layer of soil must be maintained for the infection of the grass plant to occur (Clarke, et al.). Necrotic ring spot has also been shown to increase in severity with excessive moisture and frequent irrigations (Chastagner, 1985; Smiley, 1980). The powdery mildew fungi are an exception as they require high humidity without the film of moisture on the leaf surface for germination of spores and infection to occur.

While longer periods of leaf wetness are expected to occur in irrigated vs. non-irrigated turf regardless of mowing height (Williams et al., 2001), mowing height has an impact on the humidity within the turf canopy. Higher cutting heights result in increased levels of humidity that last for a longer period of time.

This can result in a more suitable environment for infection by pathogens (Giesler et al., 2000). In addition, the amount of water and the timing of its application can prevent or contribute to disease development (Leslie, 1994, p. 388).

Turf is not the only plant type where the length of leaf wetness influences the infection rate. Gray leaf spot of maize caused by *Cercospora zeae-maydis*, a major foliar disease is known to increase in severity as leaf wetness increases (Bhatia and Munkvold, 2002). Even apple scab due to *Venturia inaequalis*, (Harman et al., 1999), and the infection of flax due to *Alternaria linicola* (Vloutogloue et al., 1999) increase with the length of leaf wetness.

Specifics:

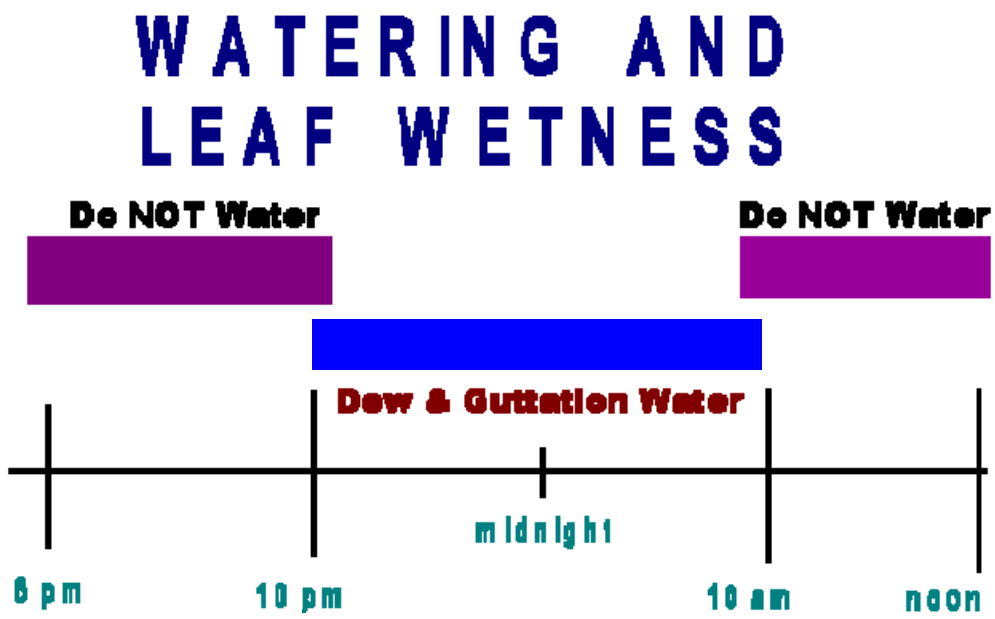
Ascochyta leaf blight control includes irrigating grass early in the morning hours when dew is already present (Smiley, et al. 1993, p. 11). This disease compendium (p. 14) also mentions that dollar spot occurs when dew is present by the growth of the fungal mycelium. This mycelium requires a period of leaf wetness for the cobwebby structure to develop. Watering early in the morning as previously mentioned would dilute the nutritional benefits of the dew thereby reducing dollar spot problems.

Control for the "Helminthosporium-type" diseases (melting-out and leaf spot) include avoiding frequent short irrigations, especially in the evening (Smiley, et al., 1993. p. 40). Extended periods of leaf wetness are reported to be required for *Curvularia*, one of the "Helminthosporiums" (Brown, et al. 1972) and the severity of both the leaf blighting and crown rot phases of `*Dreschlera*' caused diseases are favored by extended periods of leaf wetness (Couch, 1995, p. 106).

Recommendations:

Practices should be followed that keep the leaf wetness less than twelve (12) hours (Couch, 1995, p. 252). Twelve (12) or more hours of moist foliage can trigger a major disease outbreak. The shorter the time the grass is wet, the less the disease problem (Leslie, 1994, p. 389).

The infection of a plant by a fungal pathogen requires spore germination and development before tissue penetration can occur. The requirement of leaf wetness for these processes to occur in part explains the reason why leaf-spot is more serious in lawns on the north side of a building or in low areas where the turf remains moist for extended periods of time (does not dry out). The spores of some fungal organisms germinate producing a motile spore that must swim in a film of water before infection can occur (Agrios, 1988. p. 44).



Adapted from Couch, H.B. 1995. Diseases of Turfgrasses: Third Edition. Krieger Publishing. Page 253

Discussion and Recommendations

Dew forms on turfgrass about 10:00 p.m. in Western Colorado. From that point until the morning sun dries the grass blades , the grass is wet. Infection by most turf disease pathogens, however, usually does not occur as the hours are less than the 12 hour minimum. However, if the grass is watered in the early evening hours, or in the morning after the sun has risen but before the night dew has dried, the time the grass is wet is extended resulting in infection (Couch, 1995; Lewis, 1994; Smiley, et al. 1993). The graphic above demonstrates the time grasses are normally moist.

The dew that forms on turf is in part **guttation water**. This is a fluid rich in carbohydrates and amino acids exuded from the tip of the grass blade. Special structures called hydathodes exude this solution when water pressure builds up in the plant as occurs in the cool night hours. This nutrient rich solution serves as a food source for fungus to grow and infect the plant. Golf course superintendents are familiar with the technique of dragging a hose over a golf green or using bamboo poles to knock the dew off the grass thereby reducing problems with dollar spot.

Irrigating in the early morning hours dilutes this rich nutrient source restricting the growth of fungal pathogens. However, irrigating too late in the morning (before the night dew is dried up by the sun), while diluting the guttation fluids, extends the normal leaf wetness period increasing chances of disease.

Early to late evening is the worse time to irrigate as it wets the turfgrass plant and debris (thatch and mat) extending the normal leaf wetness period thus allowing foliar disease organisms to germinate and infect. Watering early in the evening also cools the grass increasing guttation which provides fungal organisms additional nutrients for growth ..

Watering in summer at midday can be effective in cooling the grass and provide some water for roots allowing the parched grass blades to recover their turgor. This will often allow drought-stressed grass to

recover somewhat before a thorough watering later that night. Routine watering in midday, however, should be avoided. (Smiley, et al. 1993. p. 78).

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