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ABSTRACT: Factors Influencing Turfgrass Evapotranspiration (Colorado-1983).

by C. M. Feldhake, R. E. Danielson, and J. D. Butler, Agron. J. 75:824-830.

Turf was established in cylinders that were 25 cm in diameter and 25 cm in depth. The container mix was soil or a preparation of 80% sand and 20% peat moss by volume. The cylinders drained over gravel. Water use was replaced regularly through the week and recorded. Mowing height, nitrogen fertility, shading, grass species and soil composition effects on evapotranspiration (ET) were evaluated. Kentucky bluegrass (*Poa pratensis* L. var. "Merion') mowed 5 cm used 15% more water than grass mowed at 2 cm (0.8 in.). Thirteen percent more water was used when 4 kg 1000m² of N was applied each month during spring and summer compared to only one application for the season, applied in the spring. Evapotranspiration by grass in 1979 was essentially the same whether growing on a clay soil or on a sand-peat mixture; however, a 6% decrease occurred for the soil system in 1980. Evapotranspiration increased linearly with solar radiation when an advective component of energy, accounting for 35% of ET, was subtracted from all solar treatments.

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If you are looking for another non-contaminating, safe and effective weed killer, try a golf club!

FUNGICIDE USE STRATEGIES FOR LAWN CARE COMPANIES

Dr. Peter H. Dernoeden
Department of Agronomy
University of Maryland

Arriving at the decision of whether to apply a fungicide to any turf area is often difficult and generally based upon economic considerations. Aside from cost, the primary determinants in using a fungicide are the prevailing environmental conditions, host species and cultivars present, and the pathogen. The environmental factor has unique implications in turfgrass pathology because the intensity and nature of turfgrass management greatly influences the environment and therefore the incidence and intensity of diseases.

Diseases can seriously damage turfgrass plants and impair the appearance of a lawn. Promoting vigorous growth through sound cultural practices is the first step in minimizing disease injury. Frequently, however, environmental stresses, traffic and poor management weaken plants, predisposing them to invasion by fungal pathogens. When disease symptoms appear, it is imperative that a rapid and accurate diagnosis of the disorder be made. The prudent manager also attempts to determine those factors that have led to the development of the disease. The most com-

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Figure 1.
Dollarspot injury on Kentucky bluegrass. Note a bleached straw color of the dead leaves and stems.

Comments and Opinions

What is Turf's Share of Nitrogen in the Environment?

Ralph E. Engel

The major part of earth's nitrogen is in the atmosphere. Significant amounts from this great gaseous source are fixed at or near earth's surface in a variety of substances (including our food and bodies). Synthesized nitrogen chemicals, precipitation, symbiotic nitrogen fixation involving higher plants, fixation of nitrogen by soil organisms and auto exhausts are some sources of non-atmospheric nitrogen that occur at the earth crust. Among the synthesized nitrogen materials, fertilizer nitrogen is an important increment.

Turfgrass, which uses only a small part of the U.S. fertilizer nitrogen, is sometimes considered dangerous and has been restricted in the New Jersey Pinelands as a nitrogen pollution danger. A little arithmetic indicates that turf fertilization is not the common major source of nitrogen in the environment. While turf growing is a big dollar business, it does not occupy a large land acreage (even in New Jersey). The maximum rate of turf-nitrogen use is approximately 150 lbs N per acre per year. On the major part of the acreage, the rate will be in the range of 0-60 lbs per acre. This is scarcely the major source of nitrogen in our environment. My beloved and valuable watchdog puts twice as much nitrogen in the area as my lawn. How does nitrogen in pet food stores compare with nitrogen in turf fertilizer usage? Lynn and Wilson (*Advances in Agronomy* 1950, Col. 2, pp 415) measured over 40 lbs. nitrogen accretion per acre per year on unfertilized grass cover. Precipitation adds approximately six pounds of nitrogen on all of New Jersey acres of rivers, lakes, roads, fields and vegetation. The quantity of nitrogen emitted from autos is considerable, but totals are not unavailable.

The various living and non-living sources of nitrogen in a soil will release nitrogen and will be associated with fixing and shifting forms through the more active parts of the growing season. Tests and analysts show 1500 to 7500 lbs./acre of bacteria, similar quantities of fungi, often a greater weight of non-living organic matter, several hundred pounds of earthworms and other sources contain nitrogen that contribute to the dynamics of this element. The quantity and shifting of nitrogen forms from these sources dwarfs the amount from annual turf fertilization. The amount of nitrogen that becomes soluble from these great natural sources are major factors which vary with the weather and the season.

A turf sod is an environmental plus for the environment. It immobilizes large quantities of nitrogen that water would carry through the soil. Grass sod holds great reserves of nitrogen which is maintained as a valuable resource for any subsequent food production that might occur on the site in later generations. Turf is a cover that can be used by people, and it serves to slow runoff of water which carries nitrogen and other chemicals into waterways and ground water.

Turf growers have always desired and hoped to be friends of the environment. My previous comments are not intended to absolve turf of any responsibility. But I will not accept the coals of fire some would heap on turf until the actual balance sheet shows more about the origin and shifting of total nitrogen in our soil and water enviroments. I am suspicious of quotes on nitrogen loss studies, in which nitrogen fertilizer is applied to turf, the nitrogen totals in the clipping and plant are subtracted from the total application, and the unaccounted remainder is called a soil-water contaminate. Such research interpretations should be replaced with studies that account for nitrogen losses in gaseous form and also consider the amount of nitrogen leaching that may occur on the natural or turf site without fertilization.

Because of our environmental concern as turf growers and for the sake of efficiency, we should follow guidelines on nitrogen use that will minimize losses. By most comparisons, turf is not the source of a large portion of the total; but we can help by keeping the quantity for the growing year within the minimal range for each grass type until turf

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ABSTRACT: Urea and Urease Activity in a Kentucky Bluegrass Turf. 1983.

by W. A. Torello and D. J. Wehner, Agron. J. 75:654-656.

Loss of nitrogen from volatilization after nitrogen fertilizer application has been studied frequently. Torello, Wehner and Turgeon showed a 10% loss with a high rate of prilled urea. At a normal rate of 49 kg N/Ha (approximately 1 lb N per M ft²) the loss with spray applied urea was 4.6% and was 1.6% from prilled urea. Previous study by others has shown great variability in nitrogen volatilization losses from urea. The role of the enzyme urease in the soil has received much study with regard to urea in the soil. Reports of its stability at temperatures under 70°C and its dramatic increase with greater amounts of organic matter stimulated the present study on thatch effects on urea nitrogen and urease behavior.

This study showed urease activities were extremely high within the thatch and aboveground tissue compared with activity in the underlying soil. This led to the conclusion that applications of urea in water or dry, where organic residue is abundant, offers greater risk of volatilization loss. Rinsing the urea into the soil was recommended to minimize this loss.

Fungicide Use Strategies
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mon cause for extensive disease injury in lawn turf can frequently be related to poor management practices by the homeowner. Abusive practices include frequent and close mowing; light and frequent irrigations; and inadequate or excessive nitrogen fertility. The development of excessive thatch layers, shade, poor drainage and traffic also contribute significantly to disease problems in lawn turf. A good case in point is Helminthosporium diseases which are particularly damaging when turf is mown too closely, given light and frequent irrigations, and when turf is excessively fertilized. Despite hard work and adherence to sound management practices, diseases often becomes a serious problem. This normally occurs when environmental conditions favor disease development, but not plant growth and vigor. For example, Fusarium blight and brown patch are most damaging when high summer temperatures stress plants and impair their growth and recuperative capacity. In this situation, fungicides may be recommended in conjunction with cultural practices that promote turf vigor.

Proper utilization and selection of fungicides is too difficult and complicated for most homeowners. Because of this, only lawn care companies can provide the most reliable lawn disease service. Fungicides, however, should not become a part of a normal application schedule. As a general rule, use of fungicides is discouraged in most home lawn situations because (a) proper diagnosis and proper fungicide selection is difficult, (b) it is generally too late to achieve the economic and aesthetic benefits of a fungicide once extensive injury has occurred, (c) lawn care companies capable of only dry or granular applications do not have the proper spray equipment or they cannot obtain the desired fungicide(s) in granular form, and (d) it may be less expensive, and better in the long-run, to overseed a damaged turf area in the autumn with disease resistant cultivars.

Where extremely high quality turf is desired fungicides will be needed in most years, particularly in the mid-Atlantic region. The indiscriminate use of fungicides or employment of numerous, preventative applications of fungicides for many diseases should be discouraged. Other than economic restraints, reasons why repeated fungicide applications may not be desirable include:

1. Fungicides may reduce the population of beneficial microorganisms in the soil, which could lead to excessive thatch build-ups.
2. Fungicides may disturb a delicate balance among microorganisms that compete with and antagonize disease-causing fungi. This may explain why some diseases recur more rapidly and cause more injury in turfs previously treated with fungicides.
3. Continuous usage of a single fungicide may lead to the development of fungal strains that are fungicide resistant.
4. A fungicide may control one disease, but encourage other diseases.
5. Possible phytotoxic or undesirable hormonal effects.

When used repeatedly, certain fungicides have been shown to enhance thatch accumulation (1,2). Benzimidazole fungicides (e.g. Tersan 1991, Bromasan, and Duosan) and sulfur containing fungicides such as mancozeb (Dithane M-45), maneb (Tersan LSR), and thiram (Tersan 75 and Spotrete) can cause thatch to accumulate by acidifying soil. The effect of these fungicides is indirect, that is, they inhibit the thatch decomposition capacity of beneficial microorganisms by lowering soil pH. Cadmium fungicides and iprodione (Chipco 26019) also may enhance thatch accumulation. In the case of these latter two compounds, thatch build-up is attributed to direct toxicity of microorganisms that degrade thatch. Fungicides may also contribute to thatch build-up by being toxic to earthworms. Earthworms help reduce thatch by mixing soil with organic matter. Benomyl, mancozeb, anilazine (Dyrene) and chlorothalonil (Daconil) have been shown to be toxic to earthworms.

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A COMMENT ON "NO-MOW" GROUNDS

Articles in the December 1983 issue on "no-mow" brought the reaction: why be concerned about the "no-mow" enthusiasts? The desire for turf evolved over the ages and is so widely preferred that it will always be a part of the outdoor environment.

My purpose for the articles was to provoke thought for those who might be sold "no-mow" landscape where it does not work and is not wanted. One of our county colleges provided a classic example of wasted dollars from inappropriate "no-mow" grounds and has now returned to mowed turf.

REE

Time is Nature's way of preventing everything from happening at once.

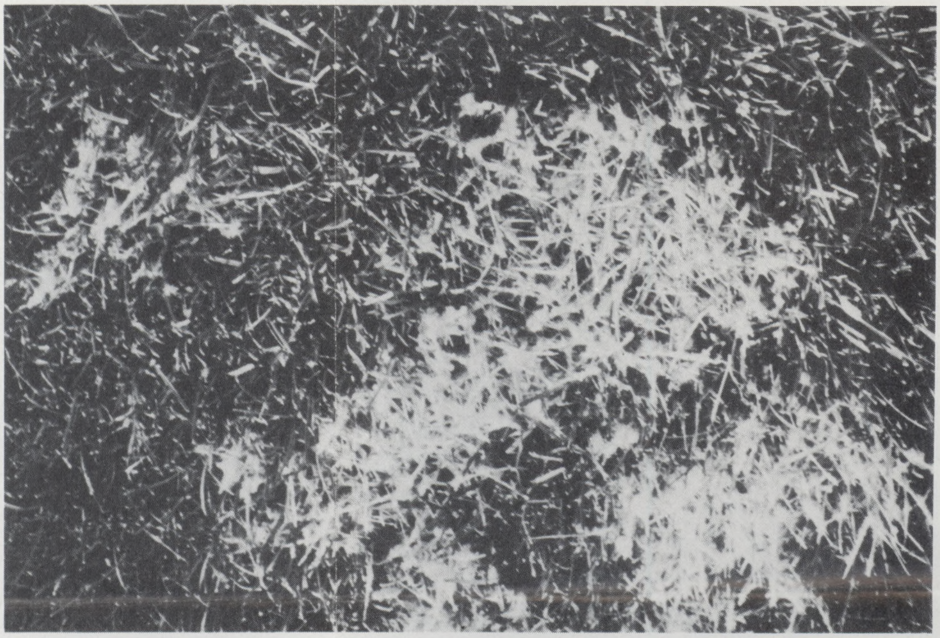

Figure 2.
Active dollarspot on Kentucky bluegrass. Note the cottony mass of mycellium. This disease may occur overnight, be inactive for a period of time or become active some days later with favorable moisture and temperature. Size of injured patches vary and may coalesce.

Fungicide Use Strategies
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Turf managers have observed that some diseases may recur in turfs previously treated with fungicides, but not in adjacent untreated areas. Dollar spot is probably the most common disease to exhibit this phenomenon. Data, recently recorded in a test conducted by the University of Maryland, have shown that red thread was more severe in the spring of 1983 in Manhattan perennial ryegrass plots last treated with benomyl in July, 1982. These phenonoma are attributed to non-target effects of fungicides, i.e. the fungicide(s) were toxic to microorganisms which antagonize and help keep disease-causing fungi in abeyance.

The development of fungal strains resistant to fungicides has been well documented. Resistant strains of the dollar spot fungus first developed as a result of repeated usage of cadmium based fungicides and benomyl on golf courses. Thiophanates (e.g. CL336, Fungo and Duosan), anilazine, and iprodione resistant strains of the dollar spot fungus have also been reported. Benomyl resistant strains of fungi causing Fusarium blight and powdery mildew, and iprodione resistant strains of the pink snow mold organism have also been reported. The development of resistant strains of fungi likely occurs in response to a selection process that eventually enables a small, but naturally occurring population of resistant biotypes to predominate in the fungicide-treated turfgrass microenvironment.

Fungicides applied to control one disease may encourage other diseases. Tests conducted in Maryland have shown that benomyl and maneb can encourage red thread. Benomyl has also been shown to enhance Helminthosporium leaf spot, Pythium blight and superficial fairy rings. Thiophanate-methyl may increase crown rust in perennial ryegrass, iprodione can increase yellow tuft, and maneb may enhance dollar spot. In a 1983 University of Maryland test, three Kentucky bluegrass cultivars treated at monthly intervals with chlorothalonil were injured more severely by Fusarium blight, heat and drought stress than untreated turf. Encouragement of disease in these situations may again be attributed to offsetting the delicate balance between antagonistic and pathogenic microorganisms in the ecosystem. It is also conceivable that some fungicides may physiologically alter the capacity of a plant to resist a particular patho-

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gen or withstand environmental stress.

It should be noted that many of the harmful side effects just described were either isolated events or occurred only after repeated use of one fungicide over the course of a year or more. Experienced turfgrass managers have long recognized that tank mixing fungicides and rotating fungicides greatly minimizes these potential problems. The importance of rapid and accurate disease diagnosis, and the judicious use of fungicides are integral in management programs.

Fungicides may be applied preventatively (i.e. before anticipated disease symptoms appear) or curatively (i.e. when disease symptoms first become evident). Applying a fungicide after the turf has been damaged significantly is generally a waste of time, money and effort. Curative applications are more economical and environmentally wise.

Many of these diseases are effectively controlled with curative fungicide applications when disease symptoms first appear. Once a disease has severely reduced stand density, fall overseeding with resistant cultivars is normally suggested as opposed to use of fungicides. Also, repeated use of fungicides is discouraged for reasons previously discussed.

Contact fungicides are less expensive and provide good control. Contact fungicides, however, may provide only 7-14 days of control under high disease pressure conditions. Where sudden and severe, or chronic disease problems occur, a systemic alone, or a systemic plus contact may be needed. Systemic or local systemic fungicides will provide 14-21 days protection during high pressure disease periods. Tank mixing a systemic plus a contact fungicide provides a longer residual effect and a wider spectrum of control. Frequently, a fungicide may only be needed to help the turf better survive a high pressure disease period.

One lawn care company in Maryland provides fungicide treatments on an "as needed" basis without additional cost to the client. They estimated that only 5% of their customer accounts require a fungicide treatment. Of that 5%, only 10% require a second treatment in the same season. They use a specialist who is trained to accurately diagnose turf diseases and to understand the importance of the environment in disease causation and the relative susceptibilities of the turfgrasses to disease. In most situations what the homeowner believes is a disease problem may actually be a cultural problem, or the disease is injurious because of poor management practices. Normally, shifts in weather patterns to conditions that enhance turf growth and adherence to sound cultural practices will dramatically reduce and help minimize most lawn disease problems. In general, a single, or possibly two, properly timed applications will provide effective control of most disease problems encountered.

Literature Cited

1. Joyner, B. G. and H. B. Couch. 1976. Relation of dosage rates, nutrition, air temperature, and suspect genotype on side effects of systemic fungicides on turfgrasses. Phytopathology 66:806-810.
2. Smiley, R.W. 1983. Compendium of turfgrass diseases. American Phytopath. Soc., St. Paul, MN. 102 p.

COMMENTS:

Dr. Dernoeden makes it clear that fungicides on lawn turf have both plus and minus concerns. Along with this, he accepts the premise that we have reached the stage when more lawn fungicides may be appropriate in some specific situations. Considering the available good new fungicides and the desire for prime turf, where does this work begin? One occasion is for high quality lawn turf that is suddenly attacked by dollarspot. Another occasion that may give valuable results is an applicaton on lush turf at the start of very hot wet weather that may persist for 5 to 10 days. A third occasion might be shade turf after vigorous growth and prolonged wet weather starts in mid- to late-spring. Follow Dr. Dernoeden's suggestion of careful identification of turf injury. Also, as a professional, leave an untreated check strip occasionally for evaluation of results. In the meantime, use good management.

Will pesticide use be regulated by fear or by Science?

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need is demonstrated. Smaller and more frequent applications are usually more efficient than one large application.

If this procedure with its increased application costs are too great or unfeasible, increase the percentage of slow release N. If rain does not follow application, apply a light rinsing with water from irrigation to minimize fertilizer loss from the site. Observe your results and watch research for guidance on the most efficient weeks of the growing season for the best fertilizer response of the given species. Also, manage to reduce turf failure which reduces the need for greater nitrogen use for turf reestablishment.

Geologists estimate the world is 5000 million years old and that 200 million years ago the current phase of continental drift started. It is now known that the continents of Earth are still moving at the rate of between 3-5 cm per year.

South African Panorama

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The supreme happiness of life is the conviction of being loved for yourself, or more correctly, being loved in spite of yourself.

Victor Hugo

Evapotranspiration
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COMMENTS:

The study gave good answers on water loss by evapotranspiration. The greater loss of water with the higher cut was not surprising because of the greater evaporating surface, but closer cut turf tends to give higher nitrogen plants with lower carbohydrate content which should increase water loss. The results suggest this was not the major influence on ET. While the study gives valuable information on factors that affect water loss, be careful about applying the results for turfgrass survival. Greater rooting depth, rhizome development and soil depths are variables that influence survival; but were not included in the study.

So live that your friends can defend you, but never have to.

Arnold Glasow