MICHIGAN TURFGRASS REPORT

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TURFGRASS VARIETIES

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The selection of adapted turfgrasses is essential to the development of a good turf. Planting turfgrass species unadapted to a particular site, environment, soil condition, management level or use will result in failure or an inferior turf.

Permanent turfgrasses such as Kentucky bluegrass and red fescue should compose a major portion of most seed mixtures planted in Michigan. Cheap, quick growing seed mixtures are generally a poor buy, since they may contain large quantities of temporary and weedy perennial grasses which are unsuited for a high quality permanent turf.

Only quality seeds which meet certain minimum purity and germination percentages should be used. The Michigan Seed Law requires proper labeling for germination, purity, and composition of grass seed mixtures. However, the buyer is responsible for selecting the properly adapted variety or mixture. Details of the seed standards for the common turfgrasses used in Michigan are listed in Late Report 1351.2.

PERMANENT LAWN GRASSES

KENTUCKY BLUEGRASSES

Kentucky Bluegrass (Poa pratensis), the most widely used turfgrass in Michigan, is best adapted to well-drained, heavy, fertile soils. It is a perennial, cool season turfgrass having good sod forming characteristics due to its rhizomatous growth habit. Generally the Kentucky bluegrasses are not adapted to intense shade. There are a number of varieties of Kentucky bluegrass, some having distinctly different management requirements. It is important to carefully select the variety best suited to the particular management level desired. Kentucky bluegrasses should be mowed at 1 1/2 to 2 inches. Cutting shorter than 1 1/2 inches will seriously weaken the turf. Kentucky bluegrasses are widely used on lawns, athletic fields, institutional grounds, fairways, tees, roadsides, cemeteries and airfields.

COUGAR - Is a moderately low growing variety with a similar leaf texture to Merion. Numerous leaves are oriented horizontally. It tends to have a blue-green color. It is highly susceptible to leafspot and is moderately susceptible to stripe smut and powdery mildew. Use of this variety in Michigan is suggested only for the northern half of the lower peninsula where leafspot is not a problem. The outstanding attribute of Cougar is the excellent drought tolerance and drought recovery on sandy soils.

DELTA - This variety of Kentucky bluegrass is similar to Kenblu. It is as susceptible to leafspot as Kenblu Kentucky bluegrass but recovers from injury much more rapidly. It is fairly resistant to stem rust and powdery mildew. The variety is outstanding in establishment vigor. Delta can recover from drought fairly quickly. The growth habit of Delta is quite erect.

FYLKING - Has a dense, low growing habit of growth of relatively fine leaf texture. Its establishment rate is satisfactory. Fylking is reported to have good resistance to leafspot and stripe smut and a moderate resistance to stem rust. It is moderately susceptible to powdery mildew. Fylking has had only limited testing under Michigan conditions.

KENBLU - Has superior early spring and late fall growth and color but becomes dormant in midsummer. This turfgrass is highly susceptible to leafspot diseases which cause severe thinning and browning in early summer. Although resistant to leaf rust, it is quite susceptible to powdery mildew which can cause severe injury in shaded areas. Kenblu Kentucky bluegrass withstands traffic moderately well and should be a basic component of a majority of lawn mixtures in Michigan which are to be maintained at a medium to low fertility level. In the past this variety has been known as Common. However, Common is a category of seed and not a specific variety.

MERION - This Kentucky bluegrass variety produces a turf of high quality and density when properly managed. It forms a medium textured sod having a wide, dark green leaf. Its chief attribute is resistance to leafspot disease, which results in superior summer growth when compared with Kenblu, Delta, Park, Newport, etc. It is highly susceptible to powdery mildew which can cause severe thinning under intense shade. Stem rusts are also a problem with Merion but can be overcome by a good nitrogen fertilizer program. Merion is highly susceptible to stripe smut, which is most prevalent under heavy thatch conditions. Although stripe smut has been found in Michigan, it has not as yet become as severe a problem as in states to the south. Merion also shows considerable susceptibility to a new disease which has been called Fusarium blight. With the advent of cool fall weather, Merion shows a reduced growth rate and turns a characteristic purplish-green color. Merion has superior ability to tolerate and recover from droughts and therefore would be better adapted, than most bluegrass varieties, to light sandy soils. Merion is comparatively slow to establish. It demands a high management level compared to most other bluegrass varieties and requires twice the rate of nitrogen fertilization (6-8# of actual nitrogen per 1,000 square feet per year). Merion tends to thatch more than other bluegrasses due to its vigorous, dense growth habit. Merion should be used only by individuals interested in investing the extra time and money required for a high quality turf.

NEWPORT - A Kentucky bluegrass variety similar to Merion in growth habit which blends well with Merion. Its main virtue is excellent fall vigor which is desirable for football fields. It is not as vigorous in rhizome production and sod formation. The leafspot resistance of Newport is not adequate with severe thinning frequently occuring in the third and fourth years. Newport is moderately susceptible to stripe smut. It has shown some resistance to the current races of leaf and stem rust as well as to powdery mildew. It should not be used on droughty sites since it is very poor in drought tolerance and drought recovery capability. Newport seems to prefer a medium high nitrogen fertility level. It has a medium rate of establishment. Newport tends to become very stemmy at seedhead setting in June.

PARK - Has an erect growth habit and a rapid growth rate. Its rate of establishment is superior. Park has shown good resistance to stem rust and stripe smut but is highly susceptible to leafspot. The performance of Park has been better in the northern half of Michigan.

PRATO - Is a Kentucky bluegrass of superior density and relatively fine leaf texture. It has a fairly rapid rate of establishment. Prato has moderate susceptibility to leafspot but is quite susceptible to stripe smut. It is a moderately low growing variety with rather horizontal leaf blades. This variety was originally selected in Holland.

WINDSOR - Is a dark green, moderately low growing Kentucky bluegrass. It has moderate susceptibility to leafspot, powdery mildew and rust. Windsor responds to high nitrogen fertilization similar to Merion. It has had only limited testing under Michigan conditions.

BLUEGRASS BLENDS

The blending of several bluegrass varieties which possess varying disease resistant characteristics is preferred. The blend is suited to a broader range of adaptation and disease tolerance than a single variety. In general, blending reduces the incidence of any one disease on any one bluegrass variety contained in the blend.

RED FESCUE

Red Fescue (Festuca rubra) is a perennial, cool season turfgrass of fine texture particularly adapted to light, sandy soils, shaded conditions and lower management levels. It is superior to the bluegrasses in establishment vigor and, when mixed with bluegrasses, often serves as a valuable companion grass. Excessive nitrogen or water will cause severe thinning of red fescue. Normally, 1 to 2 pounds of actual nitrogen per 1,000 square feet per year is adequate. All commercially available varieties of red fescue are susceptible to the leafspot diseases which can cause extensive patchy, areas of dead turf in midsummer. Available varieties include Pennlawn, Rainier, Illabee, and Trinity red fescue which spread by underground creeping stems and Chewings red fescue which has a bunch type growth habit. All of these varieties are similar in turfgrass performance with a slight edge to Pennlawn and Rainier in terms of overall quality. Pennlawn is the preferred red fescue variety in Michigan due to a superior drought recovery capability and better low temperature tolerance. Chewings red fescue has a rapid establishment capability on sandy soils. A minimum cutting height of 1 1/2 inches is recommended. If any percentage of "other crop" is listed on the label when purchasing red fescue seed, be sure it is not tall fescue.

SPECIAL PURPOSE TURFGRASSES

ROUGH BLUEGRASS

Rough bluegrass (Poa trivialis) is a light green, prostrate growing, perennial turfgrass which is adapted to moist, shady conditions. It is superior to Kentucky bluegrass in establishment vigor but will not tolerate traffic or hot, dry conditions due to its shallow rooting habit. The light green colored rough bluegrass does not blend well with most turfgrasses; therefore, it is not used to any extent.

BENTGRASS

Bentgrass (Agrostis sp.) is a vigorous perennial turfgrass with the ability to withstand close cutting (down to one-quarter inch). It is used primarily on putting greens and fairways of golf courses. It requires extensive, costly management including the use of fungicides due to its high susceptibility to diseases (dollarspot, brown patch, snow mold, etc.). As a result of the high cost and specific management requirements, its use is limited as a lawn grass in Michigan. Stoloniferous bentgrasses are a serious weed in Kentucky bluegrass turfs. Bentgrasses are favored by wet soils, close mowing and high fertility.

TEMPORARY TURFGRASSES

PERENNIAL RYEGRASS

Perennial ryegrass (Lolium perenne) is a short-lived perennial due to its susceptibility to winterkill. A major portion of a perennial ryegrass stand will be killed during the initial winter with complete killing by the end of the third winter. It has a bunch type, non-creeping growth habit.

Perennial ryegrass is susceptible to rust and is difficult to mow due to the tough, fibrous nature of the leaves. Its main attribute is rapid germination and establishment which makes it an ideal grass to be used as a temporary lawn or as 20% of a mixture to serve as a soil stabilizer and cover until the slower permanent turfgrasses become established. The problem is to avoid excessive competition from the ryegrass which may crowd out the desired permanent turfgrass contained in the mixture.

ITALIAN RYEGRASS

Italian Ryegrass (Lolium multiflorum) is an annual, bunch type turfgrass. It is slightly superior to perennial ryegrass in germination and establishment vigor. It has a lighter green color and coarser leaf texture. Its use is similar to that of perennial ryegrass.

REDTOP

Redtop (Agrestis alba) is a gray-green, short-lived perennial grass which tends to thin out under turf maintenance. As a result, it persists as scattered tufts which disrupt turfgrass uniformity. Its main advantage is rapid germination and tolerance to wet, acid soils. However, it is of little value in quality turfs.

TURFGRASSES NOT WELL ADAPTED FOR MICHIGAN

TALL FESCUE

Tall Fescue (Festuca arundinacea) is a grass that is frequently misused. It is a coarse-textured, perennial which resists heavy wear, high temperatures, and drought. Tall fescue is vigorous in establishment but susceptible to snow mold and subject to winterkilling under close mowing and high fertility. The two most common varieties are Kentucky 31 and Alta which are very similar in performance. Due to the coarse leaf texture, tall fescue is generally not suited for home lawns. If planted as less than 70 percent of the mixture, it becomes clumpy and undesirable. Tall fescue is used on athletic fields and heavy use areas where wear is excessive.

ZOYSIA

Japanese Lawngrass (Zoysia japonica) is a perennial, warm season turfgrass which turns straw colored with the first bad freeze in the fall and remains brown until late spring. It is established vegetatively by sprigs or plugs and generally requires two growing seasons for complete establishment. The Meyer and Midwest varieties are relatively winterhardy in southern Michigan. Emerald will winterkill severely. Zoysia is not a desirable turfgrass for most situations found in Michigan.

LAWN SEED MIXTURES

Turfgrasses are grown under a wide range of soil and environmental conditions. Thus, a mixture of desirable perennial turfgrasses offers distinct advantages. Shade, sandy soil pockets and exposed subsoil from excavations are conditions which require specific turfgrasses.

The following is offered as a guide in selecting a turfgrass mixture for use under four specific conditions. Quality turfgrass mixtures which fall within the percentage ranges listed are available or may be purchased individually and mixed. Percentages are given on a weight basis.

A. Sunny areas of medium to low maintenance (2 to 4# of N per 1,000 sq. ft. per year).

Kentucky Bluegrass (A blend of 2 or 3 varieties)	70 to 40%
Red Fescue (Pennlawn)	30 to 60%

B. Sunny areas of high maintenance (6-8# of N per 1,000 sq. ft. per year).

Merion Kentucky Bluegrass	20 to 10%
Kentucky Bluegrass (A blend of 2 or 3 varieties)	50 to 30%
Red Fescue (Pennlawn)	30 to 60%

C. Dry, shaded areas of low maintenance:

Red Fescue (Pennlawn, Chewings)	80 to 50%
Kentucky Bluegrass (Newport, Delta)	20 to 50%

D. Moist, shaded areas:

Creeping Red Fescue (Pennlawn)	70 to 40%
Kentucky Bluegrass (Newport, Delta)	20 to 30%
Rough Bluegrass	10 to 30%

Use the high percentages of red fescue on light sandy soils. Add 20 to 25% ryegrass to the seed mixture under the following adverse conditions:

a. Improper time of year for seeding such as mid-summer.

b. Steep sloping areas which are subject to erosion.

c. During droughty periods when the area cannot be properly irrigated.

A seeding rate of from 2 to 3 pounds per 1,000 square feet is suggested for the bluegrass-red fescue seed mixtures. When a ryegrass is added increase the rate to 4 pounds. Bentgrass, redtop, tall fescue and timothy should not be used in lawn seed mixtures where a high quality turf is desired. They eventually produce a patchy and otherwise undesirable appearance. These weedy perennial grasses cannot be selectively removed from the desirable turfgrasses with the herbicides now available. As a result they can become the most undesirable of turfgrass weeds.

SEEDING RATES AND QUALITY SEED CHARACTERISTIC OF TURFGRASSES

Turfgrass	Scientific Name	Minimum Purity (%)	Minimum Germination (%)	Approximate Number of Seeds per Pound	Seeding Rate In Pounds Per 1,000 sq.ft.	Major Use
Bentgrass, colonial	Agrostis tenuis	98	90	8-9,000,000	1-2	Greens, fairways, tees and high quality lawns
Bentgrass, creeping	Agrostis palustris	98	90	7-8,000,000	0.5-1	Greens, tees, and fairways.
Bentgrass, velvet	Agrostis canina	95	90	9-10,000,000	0.5-1	Greens.
Bluegrass, Canada	Poa compressa	95	85	2,496,000	1-2	Low fertility, coarse textured turfs.
Bluegrass, Kentucky	Poa pratensis	90	75	2,200,000	1-2	Major component of most general use turfs
Bluegrass, rough	Poa trivialis	92	85	2,500,000	1-2	Moist, shaded areas.
Red fescue	Festuca rubra	98	85	455,000	3-5	Lawns and general use turfs; light soils and shaded areas.
Redtop	Agrostis alba	95	90	5,000,000	1-2	Temporary cover; for acid, wet, non-use areas.
Ryegrass, Italian	Lolium multiflorum	98	90	226,800	5-7	Temporary cover.
Ryegrass, perennial	Lolium perenne	98	90	226,800	5-7	Temporary cover.
Tall fescue	Festuca arundinacea	98	85	226,800	4-6	Coarse textured turfs; sites with heavy wear.

Sodding a Lawn

by

Paul Rieke and Robert Lucas, Soil Science Department

and

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The use of sod in establishment of turfgrass areas has become a common practice. There are many situations where sodding is to be preferred, such as on sloping areas and places where seedlings do not become well established because of traffic conditions, or when an immediate turf is desired. Certain precautions are suggested in order to insure good sod establishment. Many of the practices are similar to those required for establishing turf from seed.

1. Control Weedy Perennial Grasses

Weedy perennial grasses such as quackgrass, tall fescue, or bentgrass should be controlled prior to sodding. Amitrol-T can be used at 4 pounds per acre or 16 teaspoons per 1000 square feet. Sod can be laid in 4 to 5 weeks if the soil is thoroughly tilled.

2. Provide for Drainage

If tile drains are to be used, the soil should be allowed to settle over the trench areas prior to sodding. Special care will probably be needed to pack the soil in the trenches in order to prevent subsequent settling and repair. For small turfgrass areas, a gentle slope (1/2 - 1 percent) away from the building should provide adequate surface drainage in most cases.

3. Prepare the Soil

For a fine quality turf which requires not excessive maintenance, poor soils should probably be altered. If adequate loam or sandy loam topsoil is not available, sandy soils may be improved with the addition of 2 to 4 inches of loam or peat followed by working the soil to a depth of 5 to 6 inches. If the soil is very high in clay, 2 to 4 inches of sand and peat can be mixed with the clay soil.

Soil which is to be sodded should be tilled in much the same way as in preparing for seeding. Large clods should be broken up, sticks, stones and other debris should be removed, and the soil surface smoothed.

4. Fertilize the Soil

Fertilizer and lime should be applied according to soil test. A testing service is available through your county extension service office. If the pH is below 5.5 to 6.0, lime should be applied prior to establishment.

If soil tests are not available, a complete fertilizer can be applied at the rate of 15-25 pounds per thousand square feet. This fertilizer should probably be of a 1-1-1 type such as 12-12-12. On soils which have had no past fertilization record and particularly on subsoils, use of a complete fertilizer should be continued for one to two years.

Fertilizer and lime should be worked into the soil to a depth of 2 to 3 inches or more. The soil should then be rolled and smoothed to the final contour.

5. Purchase Good Quality Sod

The sod should be free from broadleaf annual weeds and weedy grasses (bentgrass, quackgrass, nutgrass) and should contain those species of turfgrasses recommended for the location to be sodded. Merion bluegrass sod should not be used in shady areas. Red fescue-bluegrass mixtures are more desirable under shady conditions or on droughty, sandy soils.

Blends of Kentucky bluegrass including two or three of the following (Common, Merion, Delta, Park, Prato, Windsor, Fylking, Kenblu, Cougar, and Newport) have been found to be more desirable than when single species are used alone because of a broader base for disease resistance.

6. Lay the Sod

Do not allow the sod to heat while piled previous to laying.

Sod should not be laid on dry soil. A soil that is moist but not saturated to a depth of 6 inches or more allows the new roots to become established rapidly. Staggering the ends of the pieces of sod will prevent lines across the turf caused by slow establishment at the edges of the sod pieces. Make sure that the edges of the sod are in good contact with each other but not overlapping. Once the sod is laid, roll to insure sod contact with the soil. Roots will dry out rapidly if air pockets are left between the sod and the soil. If sod is laid on a slope, it may be necessary to peg the sod strips to prevent slippage.

7. Water Properly

A thorough watering immediately after the sod has been rolled is an essential step. As a general rule, watering will be necessary every day at noon in order to keep the sod moist until the roots have grown into the soil and to avoid atmospheric drought. Once the sod is established, watering can be reduced to once a week or less, depending on when the grass wilts.

8. Use Good Management Practices on the Established Turf

Sod can be laid during nearly any time of the year if the soil is not frozen or covered with snow. Problems may exist with late fall sodding since the grass may dry out and die due to desiccation during the winter, especially, if the sod does not have an opportunity to become rooted before the ground freezes. During other portions of the season, sod can be laid any time the soil is dry enough to allow soil preparation. Sodding should be avoided during droughty periods, especially in midsummer, if facilities are not available for adequate irrigation.

After the sod is established, good management practices will be necessary to maintain a high quality turf.

TURFGRASS RESEARCH REPORTED

AT MICHIGAN CONFERENCE

By Joseph J. Marks

EAST LANSING, Mich. -- More than 500 professional turfmen attended the Michigan Turfgrass Conference, March 20-21, at Michigan State University and heard reports on late research developments and recommendations.

Here, in a nutshell, are highlights of reports given during the meeting:

---Variety "blends" produce better turf than any single variety grown alone.

---Organic sod has more root development, will not wilt as readily during a water shortage and generally establishes more rapidly than sod grown on mineral soils.

---Pesticides of the organic phosphate type can stimulate turfgrass growth by making nitrogen more readily available to the turfgrasses.

---The best all-around control of broadleafed weeds can be provided with a combination of 2,4-D and 2,4,5-TP.

---A mixture of soil, sand and organic matter in the proper ratio provides a good base for establishing putting greens, if this layer is above coarse sand and gravel to allow good drainage.

Variety "Blends" Best

The report on variety "blends" producing better turf than any single variety grown alone was made by Dr. James Beard, MSU turfgrass researcher. Since there are no "ideal" varieties, he said, blending together several varieties provides a higher quality turf adapted to a wider range of soil management and environmental conditions.

An example would be a blending of Merion, Newport and Delta to establish a good bluegrass turf. Merion is attractive and resistant to leafspot disease, but it requires high management and does not adapt to shade. Newport is better adapted to shade and is fairly resistant to powdery mildew. Delta requires low management and is resistant to stripe smut.

Blends, said Beard, give professional turfmen a better chance to establish more hardy grass under a variety of conditions.

Organic vs. Mineral Sod

John King, another MSU turfgrass researcher, reported on research which showed organic sod to have some advantages over sod grown on mineral soils.

In seven different trials, noted King, organic sod exhibited more root development and better establishment than mineral sod.

In another study, King saturated sod grown on mineral and organic soils, then allowed both types to dry. He found that the organic sod lost more water, but the sod grown on mineral soil showed wilting two days earlier. Watering is more critical in the establishment of mineral sod.

Beard and King also noted that sod cut at normal thickness (3/4 inch) had better rooting and establishment than sod cut at either 3/8 or 2 inches thick.

They also reported data showing that soil should be moist at the time of laying to insure good establishment.

Best Nitrogen Carriers

Dr. Paul Rieke, MSU soil scientist, discussed the importance of fertilizer, particularly nitrogen, and he pointed out some of the shortcomings of some nitrogen carriers.

In a comparison of soluble nitrogen carriers vs. organic carriers, Rieke found that the soluble carriers are both faster acting and less expensive. The urea formaldehyde types do not give quick "green up" to turf, particularly during the cool times of the year.

He also advised turfmen to be wary of applying fertilizer through their irrigation systems. While this may seem like a more convenient method, he said, it is only effective if distributed evenly over the turf. The irrigation system must be properly designed to achieve this uniformity.

Dr. Beard noted that sod which had been produced with high levels of nitrogen tended to heat up more quickly during shipping. In early trials, however, there has been no indication that the faster heating has caused greater damage.

Pesticides Increase Nitrogen?

In another report, J. Timmerman, MSU graduate assistant in soil science, reported on his study which showed that pesticides, particularly organic phosphates, can increase turfgrass growth by making nitrogen more readily available.

Apparently, he said, certain organic pesticides stimulate the micro-organisms that make nitrogen available, but he admitted that more research needed to be done to determine why these organic pesticides have this effect.

Weed Control

Dr. William F. Meggitt, MSU crop scientist, noted that there weren't any recent spectacular "breakthroughs" in turfgrass weed control, but there were some useful guidelines to follow for an effective control program.

He said good management is the key to many weed problems, because a well-kept turf gives the grass a fighting chance against competing weeds. Herbicides can be a big help, he added, but there is no herbicide label that will claim the chemical will grow grass.

Meggitt said a combination of 2,4-D amine and 2,4,5-TP, applied at the rate of one pound of active chemical per acre, will control dandelions, plantains, clover, chickweed, black medic, creeping charlie, red sorrel and roundleaved mallow.

Soil Mixtures

Three researchers commented about the importance of a good soil mixture to the establishment of turf. And all three suggested mixtures that would reduce compaction, maintain adequate water holding capacity in the root zone and provide good drainage whenever there was a problem of excess water.

Dr. Ray Kunze, MSU soil scientist, recommended a special mixture for putting greens. This included a layer, about 12 inches thick, of a mixture of soil, sand and organic matter. Below this layer would be coarse sand (about 4 inches), then pea gravel and, finally, subsoil. Tiling would be placed in the area just under the sand in the pea gravel.

Dr. Kunze explained that the coarse sand and pea gravel did not have the "capillary attraction capacity" to draw water from the upper zone. As a result, water does not move down until the upper area is saturated.

Dr. J. Duich, Penn State University agronomist, pointed to a project which he had started in 1960 which showed that many turfmen pay too much attention to the quantities in soil mixtures rather than the quality of the sand, soil and peat. For example, he said, the important thing in concrete sand is the particle size distribution. He urged turfmen to examine this particle size to determine how well it will hold water and allow drainage.

Duich noted that with 10 percent peat in a mixture, turfmen would need 40 percent coarse sand to get any infiltration at all. They would need at least 60 percent sand for good infiltration (drainage) of water.

Duich also studied mixtures which had undergone two years of compaction. He found that the best infiltration rate was given with a mixture made of 40 percent Turface, 10 percent peat and 50 percent soil.

Dr. M. Ferguson, Mid-Continent Director, U.S. Golf Association, Greens Section, Texas A & M University, noted that the relationship of pore space between soil particles had the biggest influence on soil mixtures.

He noted that by constructing different textural layers in the proper order, a surface could be constructed that would hold enough water and still allow enough drainage for good turfgrass establishment.

Plant Diseases

Dr. M. Britton, University of Illinois plant pathologist, listed the major turfgrass diseases, noting that there has been very little success in finding a control for them. But he did have a recommendation for getting rid of much of the guttation water which encourages turfgrass diseases.

Guttation water, he explained, is a solution from within the leaf which contains nutrients that encourage turfgrass disease. Most of this solution can be removed with light applications of water (syringing) before mowing, Syringing washes the guttation water off the leaves.

Britton also noted that temperature, light and mowing affect the severity of diseases. He pointed out that most disease causing organisms have survival mechanisms (such as spores) to grow under any conditions. Free moisture keeps fungi alive outside of the plant.

Decreased light decreases photosynthesis and increases carbohydrates, said Britton, making the plant more susceptible to diseases. This decreased light also affects temperature which, in turn, affects various organisms, depending on which temperature they need to survive.

Britton also pointed out that close mowing increases plant numbers, decreases plant size and increases the effect of a single infection on turf. The smaller plants in a denser population are weaker and less able to fight off disease. Also, he noted, cut leaf tips are natural points of infection and ready sites from which guttation water can emerge and form a favorable environment for disease activity.