This tee and green have an inherent disadvantage because of the excessive shade. Currently, the chainsaw is the only practical technology to overcome this problem.

BASIC TRAINING

Technology for turfgrass maintenance is more advanced than ever, but basic management programs are still the foundation of success.

BY DARIN S. BEVARD

When buying a car, the list of potential options and amenities is endless: stereo/compact-disc player, heated seats, global positioning system, traction control, anti-lock brakes, etc. Even televisions with DVD players are now common in cars, unthinkable only a few years ago. Options whose benefits are not even known to the consumer are added to the car at great expense because the salesperson convinces us that they are a must-have. Basic items such as the engine and tires are assumed to be included. We may make different choices on these basic items, but rest assured, without them you do not really have a car. The car ceases to function without these basic elements, but consumers often place more focus on amenities. However, if the engine (a necessity) fails, the car is no longer useful; if the compact-disc player (an amenity) stops working, you can still get around town.

In recent years, more amenities or technological advances in equipment, turfgrass varieties, pesticides, and other chemicals have allowed golf course superintendents to provide daily conditions that were unimaginable even 10 years ago. Unfortunately, basic agronomic programs that

Periodic light topdressing dilutes thatch accumulation between scheduled aeration events and prevents layers of thatch from developing in the soil profile.

support these advances in technology are increasingly looked upon as boring or unnecessary. Nothing could be further from the truth.

The word *basic* pertains to a *basis*. Webster defines *basis* as "a foundation upon which something rests; the chief or most stable component of anything; a fundamental ingredient." The chance for hardship and failure increases if the basics are not given proper attention in any endeavor. Basic turf management programs are often taken for granted by turf managers and golfers. New technologies supplement basic programs, but they cannot replace them. If basic turfgrass needs are neglected over time, overall golf course quality will suffer. It is only a matter of time.

The factors that contribute to success or failure in turf management are too numerous to mention. What follows is a discussion of several basic elements that are part of every golf course management program. Properly addressing these factors will prevent a breakdown in golf course conditions.

GROWING ENVIRONMENT

Growing environment is the most basic element for maintaining healthy turfgrass. Warm- and cool-season turfgrasses perform at their best when sunlight penetration and air movement are adequate. Good drainage is also critical. Do these factors sound too simple? Maybe they are. However, on virtually every golf course, old or new, poor drainage, poor sunlight penetration, and poor air movement alone and in concert with each other contribute to management challenges on the golf course. Their impacts are frequently overlooked and ignored. The best golf course superintendent will struggle to maintain desired playing conditions, especially on putting greens, if these limitations are not addressed. Shade and poor air movement promote weak turfgrasses that are less resistant to disease, insects, and traffic, necessitating greater inputs of pesticides and other resources to maintain inferior quality compared to turfgrass grown in good growing environments.

Many techniques are available to improve drainage at the time of establishment and in existing turfgrass stands. The proper technique to use will depend upon individual circumstances. Drainage problems recur in the same areas, year after year, if they are not addressed. Mechanical damage, wet wilt, disease, and poor playing conditions are common characteristics of poorly drained areas.

Improve sunlight penetration, air movement, and turf quality by removing trees that prevent quality turfgrass from being maintained. In some situations, tree removal may not be possible. In these cases, other solutions, such as fans, may need to be considered. In most instances, resistance to tree removal is strictly political. Yet, those who rail vehemently against tree removal are often the same individuals who decry poor turfgrass conditions caused by the same trees they strive to protect. Establishing good growing conditions is the first step in obtaining good grass.

GRASS SELECTION

Selection of turfgrasses suitable for maintenance in a particular environment is critical for limiting future problems. Better quality can be maintained if grasses suited for a region's weather conditions are selected. The grass will be healthier and more resistant to disease and insect problems.

The National Turfgrass Evaluation Program (NTEP) provides excellent information for comparing newer turfgrass cultivars to each other and to previous standard entries, and encompasses broad climatic regions. For example, one creeping bentgrass cultivar may perform at a high level in Georgia but may perform poorly in Maryland because of differences in climate, disease pressure, and insect populations. These important differ-

ences can often be seen in the NTEP data. Additionally, new turf-type grasses such as seashore paspalum offer options for managing quality turfgrass in southern climates with limited high-quality water or poor soil conditions.

In spite of increases in overall quality and cold tolerance of warm-season grasses, recent trends in the transition zone have seen cool-season grasses pushed further south. Maintenance of cool-season grasses in this instance can strain budgets because of greater fungicide and water requirements during the summer months compared to warm-season grasses that may provide better playing conditions during the peak season.

In the last ten years, improvement in turfgrass varieties for putting greens, in particular, and golf courses in general, have provided unprecedented options for new golf course construction projects and renovations, but there are limitations. Plant grasses that perform best in your region. Pushing the envelope with poor grass selection will lead to expensive management challenges in the future.

NITROGEN FERTILITY

Nitrogen fertilizers have significant effects on overall turfgrass quality. Unfortunately, it is difficult to accurately predict nitrogen availability from soil tests over the course of the growing season. Weather conditions, especially rainfall, affect the availability of nitrogen and other nutrients in the profile. Nitrogen generally promotes a greater growth response than any other nutrient when applied to turf. Annual nitrogen applications on golf course turf are often low, or even inadequate, for maintenance of healthy turf.

There seems to be a certain element of pride in maintaining low nitrogen fertilizer inputs. To what end is this low-nitrogen philosophy being employed? Current and long-past research indicates the importance and benefits of nitrogen in reducing disease pressure, allowing recovery from traffic damage, and competing with weeds, including moss, on putting greens. Applications of nitrogen promote uptake of other nutrients such as potassium, even when these other nutrients are present in lower than recommended amounts.

Do not confuse adequate and excessive nitrogen fertility! People who consume a healthy, balanced diet generally will be healthier than people who overeat and become overweight. Conversely, being severely underweight is equally unhealthy. The key is to avoid extremes in either direction. Excessive nitrogen fertility can promote thatch accumulation, other disease problems, and poor wear tolerance. In recent years, however, excessive nitrogen inputs are rarely seen.

Often, the goal of low nitrogen fertility is faster putting surfaces. Reducing nitrogen fertility in the short term to achieve green speed is a common management practice that can be used successfully. Inadequate nitrogen fertility for the long term on putting greens and other turf areas promotes turfgrass that lacks density, struggles to recover from traffic, and has chronic problems with diseases. Focus on growing healthy turfgrass and implementing grooming techniques to achieve desired playing conditions.

The exact quantity of nitrogen needed for a particular turf area on a given golf course will vary significantly based upon location, weather conditions, and the number of rounds played. Any specific number that may be offered here would be arbitrary. For example, most courses' heavily used middle tees should receive more nitrogen to maintain quality compared to the less used forward or back tees. At many golf courses, all tees are fertilized in the same manner, regardless of traffic levels. This may promote excessive thatch on forward and rear tees, while middle tees become thin or devoid of turf. Clearly, a golf course receiving 50,000 annual rounds will need higher nitrogen inputs on all turf areas than one receiving 12,000 annual rounds to account for traffic effects.

Excessive thatch accumulation reduces the superintendent's ability to control soil moisture, promotes certain disease and insect problems, reduces the effectiveness of many pesticide applications, and negatively impacts playing conditions.

Look for indicators to help determine nitrogen fertilizer needs for a given area of your golf course. One obvious indicator of low nitrogen fertility is dramatic growth responses to animal droppings. High populations of clover or other legumes, in particular, may indicate low nitrogen fertility. Legumes fix their own nitrogen and easily out-compete turfgrass under low nitrogen fertility. In the Mid-Atlantic Region, persistent dollar spot disease often occurs in conjunction with low nitrogen fertility. A more subtle indicator is the failure of the turfgrass to heal from traffic and other mechanical damage, such as ball marks, in a timely manner. Monitor the growth

Above: Modern irrigation systems provide unsurpassed coverage, efficiency, and control, but they still are only as effective as those who manage their use.

Right: In many instances, only a small percentage of turfgrass areas on greens may suffer from drought stress. Hand-watering allows these stressed areas to be addressed in a site-specific area without applying water to areas where soil moisture is adequate.

rate of the turf and scout for potential indicators of low fertility. Apply fertilizers based on turfgrass need and response rather than an arbitrary number of pounds of nitrogen per year.

Nitrogen is not the only nutrient that may be deficient, although commonly it is limiting in turfgrass. Availability of other nutrients can be evaluated through periodic soil testing. Fertilizer programs then can be developed to supply necessary nutrients to allow for good turfgrass growth. Sufficient levels of all nutrients must be maintained for optimum turfgrass growth. There are varying theories on maintaining secondary nutrient levels (calcium, magnesium, sulfur). However, research in turfgrass indicates that maintaining sufficient levels of these nutrients may be more important than maintaining them in any specific ratio. Do not lose sight of the big picture of soil fertility by micromanaging for certain ratios when adequate nutrient levels are already present.

THATCH MANAGEMENT

Thatch accumulation cushions the turf from golfer and maintenance traffic, but undiluted, excessive thatch accumulation in fine turf areas eventually causes problems on fairways and putting greens. Certain insect and disease problems increase dramatically when excessive thatch is present. Thatch provides a good environment to harbor many turfgrass pests and provides challenges for managing soil moisture levels during dry weather. Thick thatch produces a barrier to water infiltration when it dries out, becoming water repellant, and making rehydration very difficult. Under wet conditions, excessive thatch acts as a sponge and increases moisture at the soil surface. Soft conditions contribute to scalping and negatively affect playability, especially on putting greens and fairways. Whether wet or dry, excessive thatch accumulation reduces a superintendent's ability to control soil moisture status.

Thatch accumulation can be managed via core aeration, light topdressing, and deep vertical mowing. These programs work best when used in combination with each other. The required amount and frequency of aeration and topdressing depend on many factors, including

length of growing season, fertility, and traffic levels. Research conducted by Dr. Bob Carrow in the 1990s suggests organic matter accumulation above 3-4% by weight in sand-based putting green soils begins a downward slide in overall turfgrass quality, because the potential for the problems discussed above are enhanced. The goal should be to prevent organic matter accumulation from exceeding this threshold. Patrick O'Brien and Chris Hartwiger have written two excellent articles, "Aeration by the Numbers" (*Green Section Record*, July-August 2001) and "Aeration and Topdressing for the 21st Century" (*Green Section Record*, March-April 2003), that discuss frequency and intensity of thatch management programs.

We know that too much organic matter (or thatch) in the upper portion of the soil profile can lead to management problems, and we have the tools to reduce and prevent thatch accumulation. What's the problem? Problems with thatch management are often political. The disruption caused by core aeration and subsequent sanding of greens reduces playability for varying amounts of time. Depending upon geographic location, a single aeration and topdressing procedure could impact a substantial portion of the golfing season, which means loss of ideal playing time at private facilities and loss of revenue at daily-fee golf courses. Do not be fooled. Over time, neglecting aeration programs for short-term gains will lead to problems with disease, turfgrass quality, and overall playability.

Implement thatch management programs when the turf is growing vigorously to minimize healing time. Aerating too early in the growing season leads to increased healing time and more golfer complaints. A short-term increase in nitrogen fertilizer inputs will speed healing of affected areas and lessen golfers' frustrations.

New technologies such as sand injection and smaller aeration tines have provided options for thatch management that result in less disruption to playing surfaces. In many instances, these tools are not being used frequently enough to keep up with thatch production, and problems develop incrementally over time. One may not even realize that the basis of turfgrass decline or failure is related to slow thatch accumulation that contributes to a variety of management challenges. Options are available to reduce disruption, but proper aeration and topdressing programs cannot be replaced.

IRRIGATION MANAGEMENT

Irrigation management varies widely across the country. In regions where cheap water is readily available, over-watering occurs too often. In the Mid-Atlantic Region, turfgrass areas are frequently damaged by too much water during the summer months, more so than by drought stress. Within

Below left: Indicators of low nitrogen fertility should be heeded. Goose droppings provide a dramatic growth and greening effect that indicates nitrogen inputs may be far too low.

Below right: Animal-supplied extra nitrogen on this putting green. Aside from the obvious greening response, note the lack of open aeration holes in the affected area because of increased nitrogen fertility.

reason, using less water is better for the grass, better for playability, and better for the environment. Under hot, dry conditions, there is often a tendency to put on more, rather than less, water to be sure that drought stress does not occur. This can promote soft conditions on greens and fairways, which upset golfers. It also places additional stress on the turf. When turfgrass is over-watered, soil pore space that is normally filled with air is filled with water, and root decline can occur due to lack of oxygen. Roots do not grow deeper in search of water. Rather, soils that have adequate moisture and oxygen levels promote deeper root development. Root mass rapidly decreases in saturated soils with limited oxygen. Water also conducts heat, increasing soil temperatures above air temperatures under hot, saturated conditions.

The complexity and coverage area of irrigation systems continues to expand. Systems costing in excess of $1 million and operated by computer are becoming the norm on golf courses. Regardless of how many bells and whistles are included with an irrigation system, the results will only be as good as the programs of the people who are pushing the buttons.

Fine turfgrass performs better when efforts are made to maintain drier conditions. That is, water should be applied only in amounts to prevent wilt or when wilt is occurring rather than on a repeating schedule that does not take actual soil moisture conditions into account. Over- or under-watering is often not noticed for several days because actual conditions are not being monitored closely. Focus management programs on meeting the needs of the turfgrass, and water only areas that truly need it.

Lack of fine tuning for varied growing environments is another overlooked factor. Protected and shaded areas will require less water inputs than open, full sunlight environments. Golfers must realize that hand-watering will be required at times to achieve the best turfgrass quality, even with the best new irrigation systems, and labor will be needed to hand-water greens. Proper irrigation requires a hands-on approach and constant attention to weather and turfgrass conditions. There are no shortcuts!

COMMUNICATION

One tool at the disposal of every turfgrass manager, regardless of golf course prestige or budget, is communication. Communication is the one tool that can pull all other programs together. Communication with course officials consists of education about golf course needs, management goals, and potential course problems and limitations. There are consequences to any management decision. When there is a problem, course officials want to know why it occurred, how it will be fixed and how long it will take, and what will be done to prevent future occurrences. In many instances, where controversy erupts over golf course conditioning or playability, poor communication and lack of understanding do more to promote the controversy than any single maintenance practice. Conversely, when interested parties communicate, controversy can often be avoided.

Not everyone is blessed with good face-to-face communication skills, but more avenues are available now than ever before for communicating. E-mail communication is commonplace, and the Internet provides a great source of information on just about every topic. Industry publications provide articles that can help you to get a point across or provide education on a particular topic. Consultants can be used as an independent third party to foster better communication between the superintendent and course officials.

Good communication is necessary so that basic turfgrass management programs can be explained and justified. Without it, well-designed management programs may be perceived as unnecessary or unsuccessful, regardless of the actual results. Lack of communication continues to be a significant problem at many golf courses.

More tools have been developed for turfgrass managers than ever before. Golf course superintendents have more options to provide top-quality turf because of advances in equipment, pesticides, and fertilizers, among other technologies. The Internet places information at our fingertips and fosters frequent communication among golf course industry professionals. However, if basic, fundamental practices are not employed, these technologies are far less valuable. There still is no product that can be sprayed or spread to replace basic agronomic practices. Are you overlooking the obvious? Evaluate your maintenance programs to be sure that basic needs of the turf are being met. Fine-tuning strategies then can be implemented to maximize golf course conditions.

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