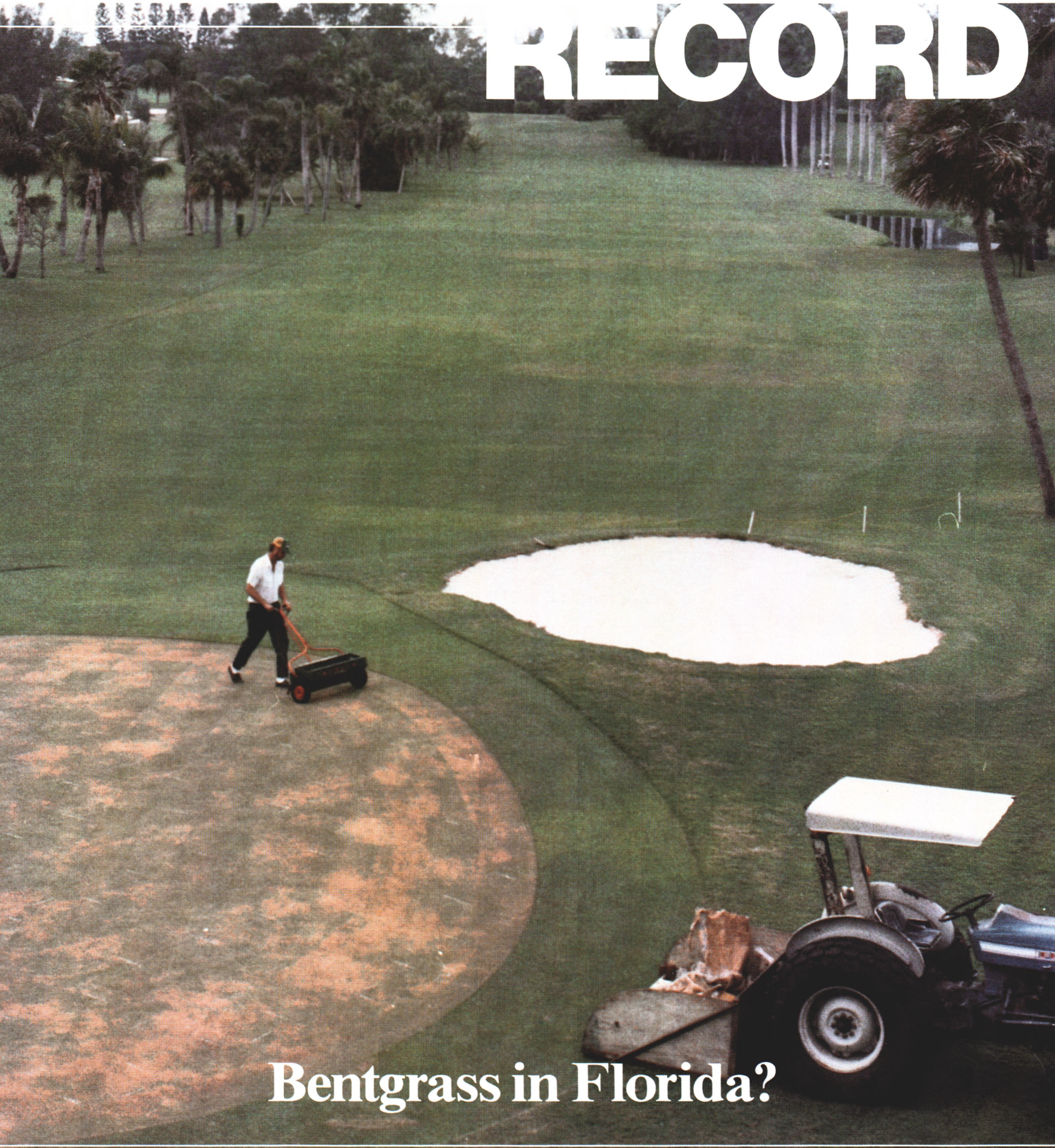
A Publication on
Turfgrass Management by the
United States Golf Association®

January/February 1988

USGA® Green Section RECORD



Bentgrass in Florida?

USGA®

Green Section RECORD

EDITOR:
William H. Bengeyfield
MANAGING EDITOR:
Robert Sommers
ART EDITOR:
Diane Chrenko Becker

Vol. 26, No. 1
JANUARY/FEBRUARY 1988

Cover Photo:

Getting ready for winter overseeding.

GREEN SECTION RECORD (ISSN 0041-5502) is published six times a year in January, March, May, July, September and November by the UNITED STATES GOLF ASSOCIATION®, Golf House, Far Hills, N.J. 07931. Subscriptions and address changes should be sent to the above address. Articles, photographs, and correspondence relevant to published material should be addressed to: United States Golf Association Green Section, Golf House, Far Hills, N.J. 07931. Second class postage paid at Far Hills, N.J., and other locations. Office of Publication, Golf House, Far Hills, N.J. 07931. **Subscriptions $9 a year. Foreign subscriptions $11 a year.**

A putting green of Tifdwarf "off color" during a cold snap.

Bentgrass or Bermudagrass Greens — What Is Right For Florida?

This Is A Regional Story, But There Are Lessons Here For Everyone!

by JOHN H. FOY
Agronomist, Southeastern Region, USGA Green Section

SOME SAY Florida is the golf capital of the world. They may be right. Within its borders are close to 800 golf courses. Flags wave over 280 courses in south Florida, and Palm Beach County by itself boasts 130 of them. And there is no indication of any decline in the booming market of golf course construction. Within the next year eight to 10 new courses will open in the Palm Beach area alone.

Each fall, as they do to other winter resort areas, visitors flood to south Florida from the north. Golfing and social activities gradually reach full swing by January, and continue full tilt into March or April. Then, shortly after Easter, the activity begins to decline, and life slowly returns to a more normal pace.

As demands for smooth, true, lightning-fast putting greens increased over the past few years, more and more courses have tried to sustain bentgrass greens, because so many believe the bermudagrasses available today can't satisfy those conditions. Because of this belief, more and more courses have become afflicted with a bentgrass mentality, and superintendents of the area are running on a vicious treadmill.

Little more than 20 years ago, Monty Moncrief, Southeastern Director of the USGA Green Section, wrote an article entitled, "Tifdwarf — Bermudagrass for Championship Greens," discussing the merits of Tifdwarf bermudagrass, a new strain developed through the efforts of Dr. Glenn W. Burton, of the USDA Georgia Coastal Plain Experiment Station. In the late 1960s, Tifdwarf was being favorably compared with northern bentgrasses for its superior putting qualities. Golfers, particularly northern golfers, have always preferred bentgrass for putting green excellence. Unfortunately, bentgrasses are also cool-season

Some Comparisons of Growth Factors and/or Requirements of Bermudagrass and Creeping Bentgrass for Golf Greens in the South

Prepared by Dr. Jeff Krans, Agronomist

Growth Factors or Requirements	Bermudagrass	Creeping Bentgrass
Optimum soil temperature for shoot growth	80-95° F	60-75° F
Optimum soil temperature for root growth	75-95° F	50-65° F
Growth limiting soil temperature	100-110° F	80-95° F
Lethal soil temperature (direct high-temperature kill)	120° F	100-110° F
Optimum response to nitrogen fertilization	April-September	March-May and again in September-November
Detrimental response to nitrogen fertilization	November-March	June-August
Acceptable pH range	5.0-7.0	6.0-6.5
Acceptable phosphorous levels	Low to high	Low to medium (excess phosphorous influences *Poa annua* competition)
Optimum potassium levels	Medium to high (low temperature survival)	Medium to high (high temperature survival)
Acceptable soil texture	Loam or sand	Sand
Irrigation capacity	Conventional irrigation adequate	Automatic syringing and irrigation required
Air circulation	Not critical	Required
Cultivation practices	May to September	April and May
Fertilizer application	Granular	Granular and liquid
Pesticide tolerance	Very good	Poor (especially under high temperatures)
Disease susceptibility	Low	High

grasses, and by nature are ill suited to the semi-tropics. In south Florida, there is only a short period of time when environmental conditions are favorable for active growth.

But before any judgments are made, a further review of the current situation for bentgrass and bermudagrass would be in order.

PLAYING two major golf championships — the U.S. Amateur and the PGA Championship — in south Florida last August put the spotlight on trying to maintain a combination of bentgrass and bermudagrass greens through the summer. Unfortunately, television coverage of the PGA Championship only highlighted the worst possible end result of this proposition. While the Amateur was more fortunate, concessions were nevertheless made, and the greens were not as fast as officials had hoped, but the mixed stand situation is only part of the picture.

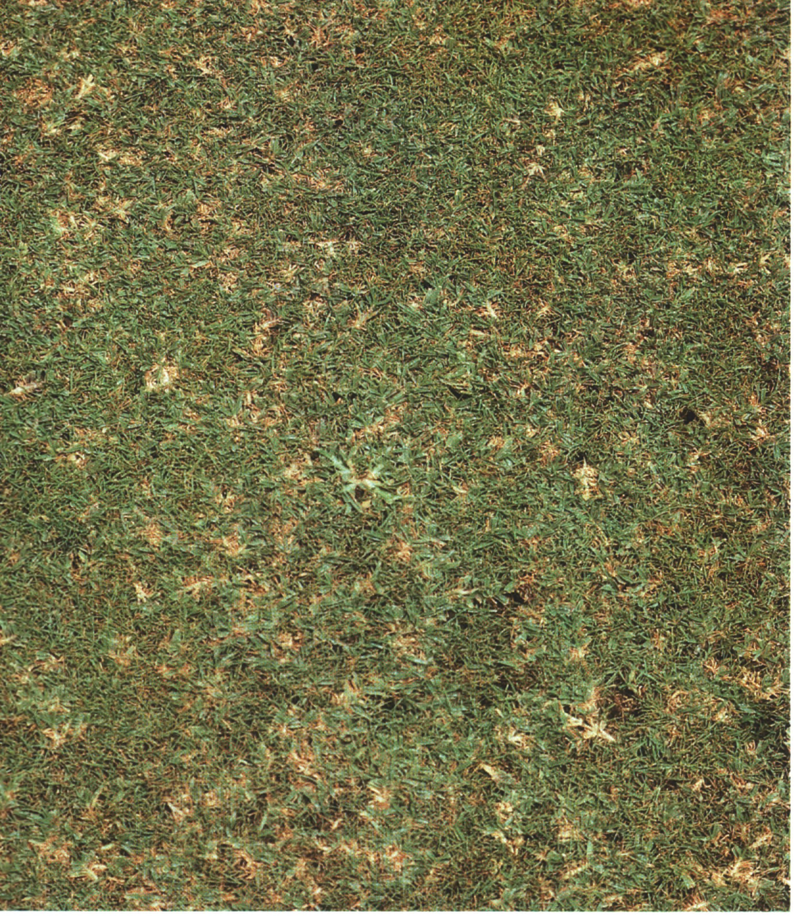
Bentgrass is used in south Florida to overseed bermuda-based greens in winter. The USDA classifies south Florida in zone 10 for plant hardiness. This means that seasonal changes are relatively indistinct, and while light frost may occur, freezes are rare. Thus, the primary reason to overseed — in order to provide an acceptable turf coverage while the bermudagrass base is dormant, is really not a consideration, because true winter dormancy does not occur. Last winter, for example, only two frosts were recorded during the entire season.

But with approximately 95 percent of the golf courses part of real estate developments (an amazing number of those in the upper price range), aesthetics is a big consideration. Because just a few days when the greens are off color might have a negative impact on sales, the developers and real estate agents want to see green greens all the time. Even after the membership takes over, the concept of winter overseeding tends to be so ingrained that it is continued.

At some south Florida courses, the extremely heavy play that occurs during the winter makes it necessary to overseed to prevent the base bermuda from wearing out when it is in a slow-growth phase. When this is the case, bentgrass overseeding is not recommended because it does not tolerate the heavy play either. Ryegrasses must be used for a successful overseeding to survive the entire season when daily play is in excess of 250 rounds. Thus again, bentgrass overseeding in south Florida is conducted primarily for aesthetic considerations, and because of the perception of significantly superior surface playability.

Overseeding with bentgrass, however, presents some special problems. Because of its relatively slow rate of establishment, seed-bed preparation and seeding must be done earlier in the fall. To assure a mature stand by early January, greens should be overseeded between mid to late October and November. Overseeding during this time of the year is a crap shoot, because environmental conditions are neither predictable nor stable. The fall of 1986 is an excellent example, when both daytime and nighttime temperatures were extremely warm — upper 80s to low 90s and mid to upper 70s, respectively — and persisted into December. These temperatures are more favorable to the continuation of active bermudagrass growth. As a result, overseeding was very difficult because of competition from the bermudagrass base turf. Also, Florida's hurricane season lasts until November, and more than one overseeding has been washed out by a late-season storm. Ryegrasses tend to be easier to work with, because seeding can be done in December, when environmental conditions have finally begun to moderate.

Bermudagrass reaches its best condition in mid-fall, when the results of all the summertime management programs and practices can be enjoyed. However, if the greens are to be overseeded with bentgrass, they will not be in their best condition, or the course may close for a period of time for the bentgrass overseeding process, when the members return. This can certainly create a negative impression that often lingers through the season, and is not the best way for the course superintendent to greet the returning membership, or to make friends. Courses that overseed with ryegrasses must also go through the establishment process, but historically, play tapers off during December. Thus the golfers initially get good bermuda greens



A mixed stand of bentgrass and bermudagrass, maintained throughout the year, on a Florida putting green in early September.

The best that can be produced in a combination bentgrass-bermudagrass putting green turf.

in mid-fall, and then come back to good winter greens in January.

ONCE winter overseeding is established, management practices are not radically different for bent or rye greens. Ryegrasses have not provided comparable quality to bent overseedings, especially for afternoon play, because of rye's extremely aggressive growth. By mid-afternoon the ryegrass has grown enough to cause the greens to be shaggy and slow. Continuing development of finer-leaved varieties is resulting in a change in this situation. Also, reduced seeding rates, better fertility management, and mixes of ryegrass with *Poa trivialis* or other cool-season varieties has further narrowed the perceived quality gap.

By the end of February and into March and April, there is no denying that bentgrass is in very good shape, providing outstanding putting greens, but when winter is over and environmental conditions are more favorable to active bermudagrass growth, it becomes necessary to begin the transition back to bermudagrass. Management practices (aerification, verticutting, topdressing, and increased fertilization) must be implemented to accomplish a complete yet gradual transition.

Over the past couple of years, a few courses have followed a passive management approach of not actually trying to force bentgrass out, but at the same time, not really trying to maintain it. The bermuda gradually became the dominant grass, but some large areas of bentgrass persisted well into the midsummer. Then, almost like clockwork, the remaining bent burned out and bare areas resulted. While the majority of the membership was in the north, the year-round residents once again had to endure less than acceptable quality putting surfaces. For the ryegrass courses, transition is much easier and is over within a few weeks.

In the past four or five years, a few courses in south Florida have tried to maintain their bentgrass overseeding, or a mixed stand, throughout the year, believing that by maintaining a certain percentage of bentgrass through the summer, the greens would not require as much time and effort to re-establish bent for the winter season. Furthermore, for Tifgreen (328) bermudagrass, which has a slightly coarser leaf blade and more open texture, if some bentgrass could be maintained through the summer, it might be possible to realize an improvement in the putting quality of these greens.

Mixed or polystands of different turf varieties is nothing new. Bentgrass/*Poa annua* greens have been with us for years, and will probably continue, but in every case showing long-term success, the turf varieties are basically quite similar in their growth requirements and environmental adaptation. As far as these factors are concerned, bentgrass and bermudagrass are definitely on opposite ends of the spectrum. The comparison chart prepared by Dr. Jeff Kranz, of Mississippi State University, provides an excellent breakdown on some of the major factors that affect growth and management of these two species.

THE THIRD WAY bentgrass is being used in Florida is in a pure monostand. Presently, a handful of courses pursue this route. Each is a new course that made a commitment from the beginning by building USGA greens, or modified versions, along with specifically designed irrigation systems. Also, money — another critically important resource — has not been a factor.

An effort to maintain pure bentgrass greens was made some 30 years ago in the Miami area. After some initial success, all of the greens were lost over a weekend during the first summer.

Much knowledge has been gained since then regarding bentgrass management, along with tremendous improvements in available pesticides and other management tools. Nevertheless, environmental conditions in Florida have not changed and cannot be ignored.

Bentgrass greens are maintained in other areas that have less than ideal summertime conditions. Some courses in the Southwest endure daytime highs well above 110 degrees, but nighttime temperatures usually drop in the desert. In addition, how long do these conditions persist during the summer? In the Phoenix-Tucson area of Arizona, winter overseeding occurs during late September, and transition back out does not happen until June, or even July. In an interesting comparison with south Florida, by April soil temperatures are 80 degrees or better, and they remain elevated well into November and even December. In other words, for at least seven to eight months, conditions are not favorable for active growth for a cool-season type turf for a good portion of Florida.

Humidity is another major factor. The western areas have virtually no humidity compared to the stifling mugginess of a Florida summer. Not only does continued high humidity greatly increase potential disease activity, it also reduces the effectiveness of syringing.

Fred Klauk, golf course superintendent of the Tournament Players Club, in Ponte Vedra, Florida, has been heavily involved with bentgrass for some time. The Tournament Players Club is not typical of the bentgrass courses in Florida, because it is a resort-type operation, with heavy play throughout the year, and is the site of the Tournament Players Championship. Klauk recently made some interesting comments on trying to maintain high-quality bentgrass greens in Florida. He stated, "Due to a consistently high disease potential, it was necessary to conduct a very intensive fungicide program throughout most of the year. The cost of this program was running $800 to $1,000 per week. Furthermore, by mid-summer, all bentgrass growth activity and recovery from damage (ball marks, traffic, and mole crickets) had ceased. It became virtually impossible to provide the quality putting surface desired during the late summer to early fall."

Klauk further stated, "The constant pressure and tremendous amount of time required to keep the bentgrass alive resulted in almost overwhelming stress for every member of the staff. Personnel burnout may be as hard to manage as the agronomics of the situation." Due to the various considerations, it has been decided that the best approach for the Tournament Players Club is to convert all the greens back to Tifdwarf bermudagrass. Bentgrass will be used to overseed the greens for the winter, but there will definitely be no attempt to hold the bent through the summer.

JUST LIKE bentgrasses, bermudagrass is not a native plant to North America. Most bermudagrasses originated in eastern Africa. Bermudagrass varieties have been introduced and are now widely distributed throughout most of the warm, humid, tropical, and sub-tropical areas of the world. While the exact date of this introduction to the United States is not clear, there are reports of bermudagrasses having been found along the coast of Georgia by the mid 1770s.

During the late 1950s and through the 1960s, Dr. Burton, working in cooperation with the USDA and the Georgia Coastal Plain Experiment Station, along with support from the USGA Green Section, released several hybrid bermudagrass varieties. These Tif-series continue to be extremely popular throughout the sunbelt.

Tifgreen (328) and Tifdwarf are the two varieties best suited for putting greens. They are both dark green, have high shoot density, fine leaf blade texture, and good tolerance to close mowing. They both also stand up to low temperatures, but once soil temperatures drop to 50 degrees, they lose their green color. A major difference between Tifgreen and Tifdwarf is that Tifdwarf is somewhat more sensitive to cooler temperatures, and it develops a purplish-black appearance.

Southerners are always disheartened to hear comments about bermudagrass greens being inferior to bentgrass greens. But it is true. Compared to bentgrasses, bermudagrasses have a very stiff leaf blade and aggressive growth. They are typically slow to putt, and are frequently grainy.

This situation is further compounded on Tifgreen greens. The grass cannot tolerate a mowing height below 3/16ths of an inch for very long without harming its health and quality. It seems that, particularly in south Florida, a lot of SOS calls are received during August and September from courses with Tifgreen bermuda greens. This is the tail end of the rainy season, when environmental stresses are quite high. Even though the grass is in a period of active growth, carbohydrate reserves have become depleted because of a constantly intensive growth rate since April or May. In the pursuit of speed, the greens invariably have been maintained at 5/32ds or even at 1/8th of an inch. Turf coverage thins, weeds invade, and usually an algae crust develops. If the height of cut is raised and sound agronomic practices are followed, complete recovery can be achieved. Unfortunately, Tifgreen bermudagrass cannot provide a putting surface comparable to modern bentgrasses.

What about Tifdwarf? When it was first released, in 1965, Tifdwarf greens were compared favorably to bentgrass greens. The Tifdwarf could be mowed at 1/8 of an inch and produce a very fast putting surface. As a matter of fact, at this height, the greens were often considered too fast for the high handicapper.

Cold hardiness is a concern with all warm-season turf species. Evaluations over the years have proved that Tifdwarf is actually more winter-hardy than Tifgreen bermuda. While Tifdwarf goes off color easily, it also greens up rapidly. In areas where true winter dormancy occurs, Tifdwarf will begin recovery one to two weeks earlier than Tifgreen bermuda. But, in south Florida, winter dormancy is about as important as a fur-lined parka.

Whenever top-flight amateurs and professional golfers putt bermudagrass greens, there is always talk about grain. Knowing which way is west, or if any large bodies of water are nearby, is supposed to help determine how much break to allow for reading the line of putt. Because Tifdwarf initially exhibited such a naturally low (and slower) growth habit, it was felt that only a minimal amount of topdressing and verticutting were required. However, now it has been found that Tifdwarf greens respond very nicely to these practices. During periods of active shoot growth, a light application of topdressing should be applied every three to four weeks, and light vertical mowing done every seven to ten days. When shoot growth activity is reduced, these practices can be done when it becomes necessary to smooth and true-up the putting surfaces. But when good management practices are followed, grain is really no longer a factor on Tifdwarf greens, and putting speed increases.

It has been my observation that the new groomer-type attachments to green mowers can be a tremendous asset in managing bermudagrass greens. Both the speed and surface trueness can be improved without having to sacrifice mowing height or turf health.

Initially it was felt that less fertilization would be required because Tifdwarf showed a very good dark green color. However, in order to realize maximum appearance and playability, a good, well-balanced fertility program is recommended. The old rule of thumb of supplying .75 to 1.0 pound of nitrogen per 1,000 square feet per growing month is still quite applicable. Also, just as with bentgrasses, maintaining a 1:1 or even a 1:2 ratio of nitrogen to potassium is extremely beneficial for good root development and improved stress tolerance.

The use of Tifdwarf was quite popular during the early to mid-1970s. However, because of a problem with the development of areas of contamination/mutation, its popularity declined. But when clean planting stock is used, and with careful monitoring of the putting surfaces, any off areas that develop can easily be cut out and replaced, thus providing a very uniform appearance and playing surface.

WITHOUT A DOUBT, bentgrasses will continue to be used for winter overseeding. It must be realized and accepted, however, that there are limitations, such as establishment timing, rate of establishment, wear tolerance, and spring transition, which reduce its suitability for a large number of courses that overseed. A few courses that have overseeded with bent have now gone back to ryegrass mixtures with truly excellent results.

As far as maintaining bentgrass in Florida during the summertime, either as a mixed bent/bermuda stand or as a pure surface, the odds are against long-term success with existing bentgrass varieties and management technology. Human nature can be such that when it is supposedly not possible, someone will try to prove it can be done. Golf course maintenance costs continue to increase to meet the demands and expectations of the players, but are they realistic and environmentally responsible?

Past criticism of bermudagrass greens has been legitimate. In recent years, however, great strides have been made, particularly in the management of Tifdwarf. I have had the opportunity to observe many truly superior Tifdwarf putting surfaces that are smooth, true, and fast. For the northern two thirds of Florida, winter overseeding is necessary to provide color and protection to the base bermuda while it is dormant. In south Florida, it is truly debatable that overseeding is necessary at all for a good number of courses. Explaining to the members that while the greens may go off color during the winter, playability is not affected (and actually, greens putt faster), would definitely cut down on operating costs and player inconvenience.

The primary objective of golf course turfgrass management is to provide a good, consistent playing surface. Given the environmental conditions of Florida, using a turfgrass species that is properly adapted is the intelligent and logical approach to accomplishing this goal. Perceptions of superior bentgrass playability will continue, but we do not expect orange trees to thrive in Minnesota, nor should we expect bentgrass to thrive in Florida.

Banyan Country Club, Florida.

Back Yard Putting Greens: Dreams or Nightmares?

by DR. KARL DANNEBERGER
Turfgrass Agronomist, The Ohio State University

EVERY GOLFER who takes the game seriously has dreamed of winning the United States Open Championship. Dreams of success are an integral part of any game. One of the dreams I have had since I first picked up a golf club is having my own putting green in my back yard. Visions of a dropping handicap and 24 putts per round danced in my head, along with thoughts of the money I would save from not having to buy a new putter every other round.

With the purchase of a home and the installation of an automatic irrigation system, the thought of that putting green became stronger. And why not? With formal training in agronomy and plant pathology, I thought maintaining a putting green would be a cinch. With what I hope will be only a minimal loss of credibility, I will describe how my dream came true.

It was early September and I was ready to go to work. The first step was to find a walking greensmower. The idea of buying a new greensmower quickly vanished when I found they cost $3,000. Luckily, though, I found an old, discarded greensmower. It needed some minor adjustments, like a new basket, a tune-up, and blade sharpening, so I took it to a distributor. Some luck. After getting the bill I made a quick trip to the bank to get a loan.

Picking the spot on my lawn where I wanted to place my green, I stripped the sod in a kidney-shaped pattern. My wife told me it looked more like Pac-Man from the upstairs window. The world will never be short on critics.

The neighbors, as an ominous sign of things to come, were curious about what I was doing. Fearing failure, I refused to tell them, which led to wild rumors of a swimming pool (dug with a hand shovel?), flower garden, and a family burial ground. Neighbors can be pretty nasty when they don't know what's going on.

Once the sod was stripped, I built the green in a modified USGA manner. (In simpler terms, "modified" meant to build it as cheaply as I could.) The modifications include no sand, no peat, and no surface or subsurface drainage. Basically, I seeded creeping bentgrass into the topsoil. There is an old saying that you get what you pay for; I was in the process of learning its true meaning.

Seedlings appeared seven days after I had sown the seed under ideal temperatures and nursed it with timely irrigation. I mowed it for the first time three weeks after seeding. Things went downhill after that. Rain fell through the whole month of November, and water stagnated on the green. My back yard had the slope of a flood plain, which only exaggerated the drainage problem. Once the temperatures dropped, ice formed. My putting green had become the neighborhood ice rink.

Spring brought flowers, budding trees, and an intensive overseeding program. Two months later I was cutting my first set of cups. I couldn't wait to get out and start improving my putting. No luck; mother nature was going to show me how difficult this was going to be.

One morning, after an evening rain, I gazed out the kitchen window expecting to see the wet bentgrass shimmering in the sunlight. Instead, I found 1,500 blackbirds pecking away. The ground was loaded with cutworms.

A week later, standing on the green in terror, I watched as a grayish mass of mycelium crept across my green, devouring anything in its path that looked green. Pythium!

Later, after an intense thunderstorm, I realized that with my drainage problem, any rain exceeding one inch would flood the green so badly I'd need a sump pump to remove it. Once the water was removed and I had changed the cups, I noticed this swamp-like odor coming from a dark-colored layer. Black layer!

My summer evenings on the putting green consisted of watering, spraying, fertilizing, and mowing. After these chores, exhaustion usually set in. Battling nature had tested my resolve, but I had come away thinking I had things under control. Wrong again. My biggest challenge still lay ahead.

Neighbors I had allowed to use the green anytime they wished were initially very impressed and excited. As the season progressed, however, they began to complain the green was too slow, grainy, bumpy, too soft, too hard, too much break, not enough break, and lacked consistency. I told them they were watching too much golf on TV.

To let my neighbors know what I could do, I decided to peak my green for the neighborhood block party. Beginning 10 days before the party, I began a maintenance program of vigorous brushing, rolling, and double-cutting. Combining this with a program of lower mowing height, topdressing, and no watering, my green would have put the U.S. Open greens to shame.

On the day of the party, the green looked and putted like glass. As I watched with a twinkle in my eye, a neighbor stroked a three-footer eight feet past the hole. The remaining neighbors headed home to get their water hoses.

That one day of redemption and the promise of no more comments was very satisfying. However, the price was high, and it took the next two months for the grass to recover. As with a sports team, putting greens cannot be peaked for an indefinite period of time without paying a price.

You may have noticed that I have not mentioned my own putting, the reason behind this mad adventure. It hasn't improved, because I haven't had time to practice.

Frankly, by the end of the summer I considered subjecting the putting green to a sod cutter. Now that it's winter and I'm looking back on the year, it was not all that bad. I wonder if this story sounds familiar to anyone?

The Dream.

The Nightmare.

Late-Season Nitrogen Fertilization: What We Do and Do Not Know

by ANTHONY J. KOSKI
The Ohio State University

LATE-SEASON NITROGEN FERTILIZATION

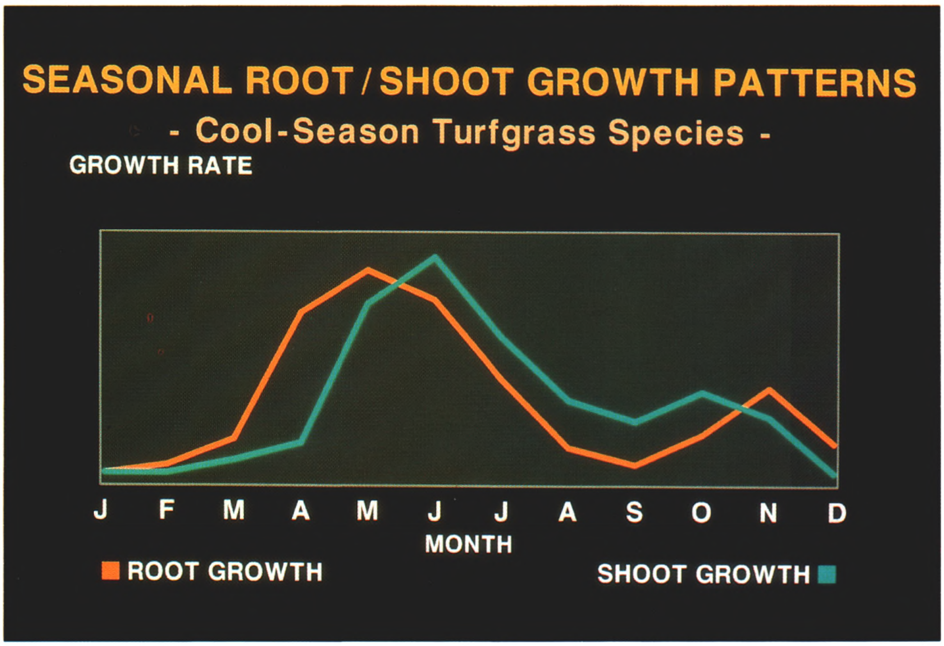
- Program recommendations* -

Timing	N Application Rate (lbs. N / 1000 sq. ft.)	Recommended N Sources
late March-April	1/2 - 3/4	IBDU, SCU, short-chain methylene ureas
late May-mid June	3/4 - 1	IBDU, methylene ureas, natural organics
late August-September	1	IBDU, methylene ureas, urea, SCU
late October-December	1-2	urea, IBDU, short-chain methylene ureas, SCU, ammonia sulfate

* For Kentucky bluegrass in Midwest & North-central U.S.

Figure 1.

Figure 2.



LATE-SEASON fertilization (LSF) of cool-season turfgrasses has been discussed often in recent years. This practice, sometimes referred to as fall fertilization, implies most nitrogen is applied from August through December. Many superintendents have long appreciated the advantages of using this fertilization philosophy in the management of roughs, fairways, tees, and possibly even greens. They have recognized the positive effects of LSF on some aspects of turf quality, including better fall and winter color, increased turf density, and enhanced spring green-up rate. These desirable effects generally can be experienced without noticeably increasing shoot growth during the fall or winter. Additionally, LSF can reduce the dependence on early spring applications (which often stimulate excessive shoot growth) to enhance the rate and degree of spring green-up.

For all of the talk about LSF, relatively little university research has been conducted on this subject. One purpose of this article is to discuss briefly what has been revealed about late-season fertilization from a research perspective, and to point to areas where further research should be directed. A second purpose is to define the how to's, when to's, and why's of late-season fertilization for those superintendents who are unfamiliar with the practice and wish to experiment with it, possibly with the intent of integrating it into their overall fertilization programs.

SINCE the early 1960s, research conducted at universities in Virginia, Rhode Island, Illinois, Michigan, Minnesota, and Ohio has provided substantial evidence to support the positive effects of LSF on turf quality. In order to achieve maximum benefits with regard to late-season color and early spring greening, follow a program similar to that outlined in Figure 1.

The program is most effective if it is begun with the August-September application of nitrogen described in that table. Proper fertilization at this time is important, because it greens up the turf following the stressful summer period, and prepares it to receive the late fall (October-December) application. It is important that the turf be green but not actively growing when this late fall application is made. The August-September application assures this. Proper timing of the late N application results in at least part of that N being taken up by the plant to enhance fall/winter color. It is not certain whether any N absorbed by the turf plant at this time plays a part in the enhanced greening the following spring, or if some of that N remains in the soil over the winter and becomes absorbed by roots during late winter/early spring. This uncertainty has important implications with regard to winter N leaching, especially on sandy soils, unfrozen soils, or in areas with high winter precipitation.

The March-April application is necessary only if 1) no late-season N applications were made the previous year, or 2) late-season N applied the previous year has not provided the desired rate/degree of spring greening. Late-season fertilization may produce poor results if N applications are not timed properly, or if rapid or unexpected changes in temperature and/or moisture occur during the fall or winter. Proper timing and normal temperatures and moisture are especially important to those nitrogen sources highly dependent on temperature and/or moisture to effect N release.

Research at Ohio State University has shown that fertilizer sources containing higher percentages of quickly available N may be somewhat easier to use for the late fall treatment in the LSF program. One reason is that the quickly available N source can cause a rapid greening response (seven days), thus widening the window during which these fertilizer sources can be used successfully. The temperature- or moisture-dependent N sources may require as much as two to three weeks lead time to generate the same degree of greening as a quick-release source. An unexpected or rapid decrease in temperature or moisture availability may reduce N release from these sources at a crucial point in the program. Secondly, a general dependence upon adequate moisture to trigger N release from certain fertilizer sources may limit their use to irrigated areas of the golf course. The fertilizer source used may even dictate how far into the fall the irrigation system must remain operational.

The May-June application is necessary to maintain adequate quality during the summer. The positive effects of N applied the previous fall begin to wear off at this time.

It is important to recognize that optimal N application dates will vary with location in the country. For example, the proper timing for the spring application in Ohio is from mid to late May, while in Michigan, Wisconsin, or Minnesota it might be in mid to late June. Similarly, Ohio locations may receive N in early to mid September and again in early to mid November. In the more northern states, these application dates may translate into August and mid to late October, respectively. Consideration must also be given to the type of N source for each application.

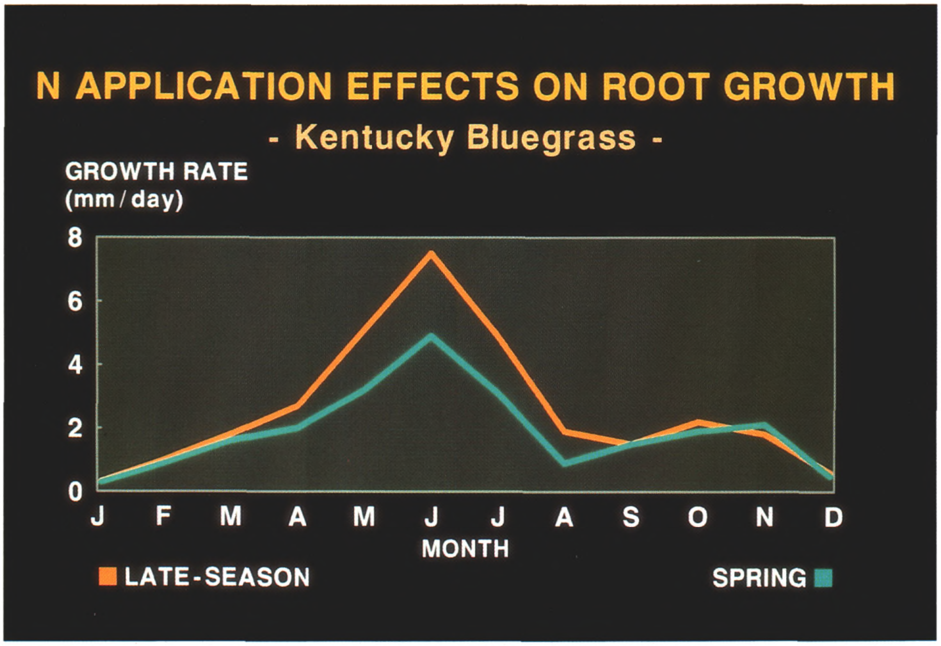
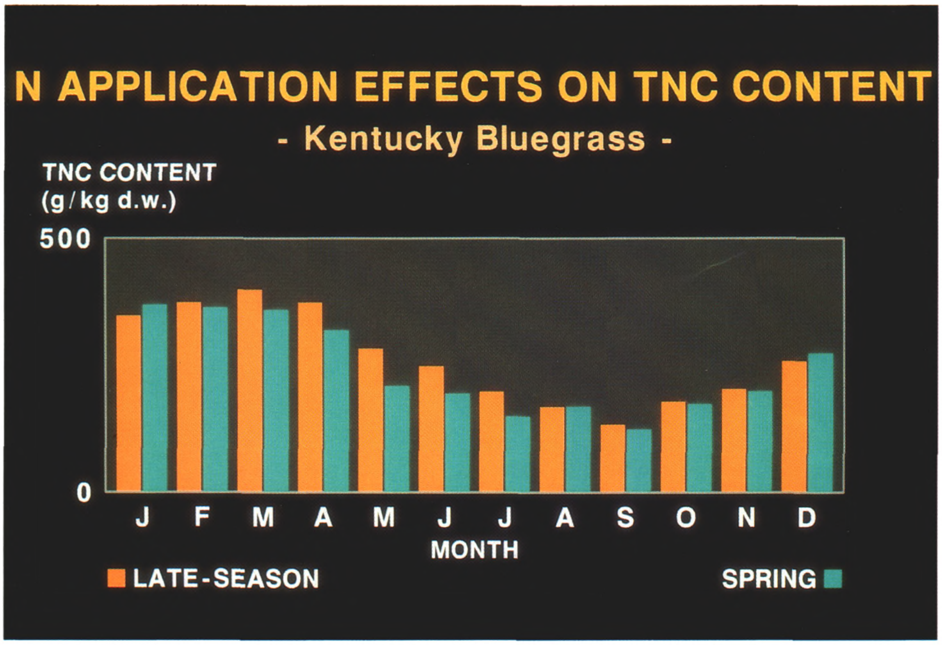


Figure 3.

Figure 4.



IT HAS LONG been hypothesized that LSF would promote fall/winter root growth because it occurs during the fall and winter at temperatures below which shoots are inactive (Figure 2). Nitrogen fertilization during the fall or winter, it was reasoned, would stimulate root growth without affecting shoot growth.

Research at Ohio State, however, has detected no such stimulation of late-season root growth by LSF (Figure 3). Root growth benefits significantly during the spring with LSF. This benefit is derived from the fact that spring greening takes place without requiring stimulation from early spring N applications. Nitrogen applied during March and/or April appears to depress root growth. This probably occurs because N-stimulated shoot activity (growth and respiration) effectively outcompetes growing roots for energy produced and stored in the plant in the form of carbohydrates (Figure 4). Thus, LSF does not actually stimulate winter or spring root growth, but instead allows spring root production to occur at a maximum by forgoing the dependence on spring fertilization to promote spring green-up.

Although LSF may slightly lower the total non-structural carbohydrate (TNC) levels during fall and early winter, the enhancement of winter color and earlier spring greening allow the plant to accumulate more carbohydrate (via photosynthesis) than turfgrass plants that are not under an LSF program. This small but detectable surplus in TNC is carried into the summer. It has not been proven that the higher TNC content confers any advantage to turfgrass plants managed using LSF, but it certainly cannot be considered disadvantageous, either.

For many years it has been suggested that LSF would lower a turfgrass plant's resistance to low-temperature injury. The previously mentioned decrease in fall/winter TNC content with LSF was considered to support this contention, since concentration of carbohydrate in plants during the hardening-off process is considered of importance in conferring resistance to low-temperature injury. However, there is little research evidence to support this contention where LSF is properly implemented.

Similarly, there is little evidence to suggest that LSF increases the occurrence of cold-weather diseases, such as the snow molds. In fact, published findings from Minnesota, Virginia, and Rhode Island indicate that LSF may even *reduce* the incidence and/or severity of some winter diseases, and may help heal turf damaged by disease.

Low-temperature injury and disease may become problems where LSF is not practiced properly, either as a result of

Figure 5. LSF study on perennial ryegrass at Ohio State showing response to 41-0-0 and SCU (left) compared to unfertilized check plots (right) at 30 days after application of 2 lbs. N/1000 sq. ft.

over-application of N, or where applications are not timed to allow for natural hardening-off. Recent (November) observations of an LSF study at Ohio State on mixed bentgrass/*Poa annua* putting green turf showed that *Poa annua* in plots fertilized in September and/or October continued to grow and remain succulent. At the same time, the bentgrass in those plots retained excellent color, and appeared to harden-off and cease growing. This would suggest that the effects of LSF on resistance to low-temperature injury and disease incidence may pose more of a concern on annual bluegrass turf. It is difficult to find information regarding the effects of LSF on annual bluegrass. This deficiency points to just one area where knowledge of certain aspects of late-season fertilization is lacking, and research should be pursued.

A number of other questions remain unanswered regarding the response of some of the cool-season turfgrass species and cultivars to late-season fertilization. Late-season fertilization studies currently under way at Ohio State are evaluating the effects of various N sources, N rates, and application timings on the quality of tall fescue, perennial ryegrass (Figure 5), and putting green height creeping bentgrass (Figure 6). Other research should examine the relationship between LSF and the quality of Kentucky bluegrass cultivars. The cultivars of this species tend to vary greatly in fall/winter color and rate of spring greening.

As new fertilizer technologies are developed, the suitability of these products for use in LSF programming must be evaluated. Another project recently initiated at Ohio State on Kentucky bluegrass is comparing new and experimental fertilizers to some of the standard N sources. These fertilizers should be evaluated for their ability to perform well in situations where water from either irrigation or precipitation is limited or unpredictable in availability.

While university research and the practical experiences of professional turfgrass managers both have revealed the advantages of late-season fertilization, it is obvious many questions remain about this concept. While continued research is important, it is just as essential to encourage the exchange of results, ideas, and concerns between researchers and superintendents. These exchanges will help stimulate productive investigations by the university researcher. They will also allow superintendents to refine LSF programs already in use, and better inform superintendents interested in incorporating the LSF concept into their current turf management programs.

Figure 6. LSF study on putting-green-height creeping bentgrass at Ohio State.

Required Maintenance Versus Available Labor — Are You Adequately Staffed?

by MARTIN MOORE
Superintendent, Birnam Wood Golf Club, California

HOW MUCH maintenance is required on a golf course? Obviously the amount varies with each course, but each course should have a formula for determining what represents an acceptable level of conditioning.

Every superintendent knows the necessary frequency for each maintenance procedure, and he also knows that the quality is diminished if the frequency is disrupted. The question then becomes, "Are there enough staff members to keep up regular maintenance and still deal effectively with additional or emergency requirements that cannot be anticipated?" If an irrigation mainline breaks, do the fairways go uncut? If high winds cut through the course, do you have the manpower to clean up the debris and still run your regular operations?

It is unrealistic to suggest that staff sizes be increased to the point where manpower is available for any unforeseen emergency. Nevertheless, in many cases available labor is not sufficient to accomplish basic maintenance and still keep up with the wishes of the membership. When you reach the point where required routine maintenance cannot be performed consistently, the quality of any golf course will suffer.

Because of this problem, the golf course superintendent should review periodically what types of maintenance he is required to perform, how long it takes, and how many man-hours are

TABLE 1

Basic Required Maintenance vs. Available Labor Analysis

To determine the extent of our man-hour deficiency, a time/task analysis was prepared (see Table 2). The total number of man-hours required to perform every necessary maintenance procedure was calculated. The composite results are as follows:

	Apr./Oct.	Nov./Mar.
Required weekly maintenance	509	380
Required periodic maintenance/weekly average	114	73
Required emergency & project maintenance/weekly average	50	24
Preparation & breaktime hours	75	75
Benefit hours/weekly average	51	51
Total weekly man-hours required	799	603
Total man-hours available *(includes all staff directly assigned to golf course)*	600	600
Deficit man-hours	(199)	(3)

Given that 799 man-hours are required to maintain the course weekly, April through October, and we have only 600 man-hours available, we are therefore maintaining the course at 75 percent of the required minimum level.

TABLE 2

Time/Task Analysis — Required Weekly Maintenance

	Day M	T	W	T	F	S	S	Apr./Oct. Total	Nov./Mar. Total/Adj.	Explanation
Change cups	4	4	4	4	4	4	4	28	28	
Putting green cups	1		1		1			3	3	
Ballwasher water		2			2			4	4	
Sandpro	3	3	3	3	4	3		19	19	
Trap touch-up	6	6	6	6		6	6	36	36	2 men/3 hours
Trap complete					16			16	16	4 men/4 hours
Cut greens jac.	16	8	16	8	16	8		72	72	4 men
Cut tees & aprons	7	7	7		7			21	14	
84″ mower	7	7	7		7			21	14	
Cut fairways	7	7	7	7	7	7		35	21	
5-gang rough	7	7	7	7	7	7		35	21	
GM 72 rough			7	7	7			21	14	
Spray greens				6				6	2	
Spot water	11	11	11	11	11			55	—	1 man/7 hours
Sweeping	4	4	4	4	4			20	20	
Irrigation maintenance	2	2	2	2	2			10	3	
Tee divots					20			20	20	5 men/4 hours
Fairway divots		16		16				32	32	4 men/8 hours
Fairway spot spray	6							6	6	
Green syringe	2	2	2	2	2	2	2	14	—	
Dew removal						8	8	16	16	
Ropes & chains	3	3	3	3	3	2	2	19	19	
								509	380	

Daily work preparation and break time = 10 minutes A.M. start-up
10 minutes A.M. break
10 minutes pre-lunch
10 minutes post-lunch
10 minutes P.M. break
10 minutes P.M. start-up

60 minutes
× 5 days × 15 men = 75 hours/week

available to get it done. Much the same as he determines how many ounces of pesticide are required to control an agricultural pest, the superintendent can determine how many people are required to perform each maintenance procedure. Just because an individual golf course has always had a 15-man crew doesn't mean that is enough to keep up with constantly increasing maintenance demands. As use increases, and with it revenues, so must the size of the maintenance staff.

Consider the number of man-hours available to be similar to a checking account. In other words, if you have 15 employees multiplied by 40 hours a week, you will have 600 man-hours. If overtime is a regular part of your operation, add this to the total. Once we have quantified the number of man-hours available, we must accurately quantify the total number of maintenance and associated work hours expected in the same period.

How do we accurately figure how much time it takes to do everything in our operation? In my case, the daily maintenance records for the past few years were reviewed. In a very short time, patterns developed, and based upon historical performance, I was able to come up with some pretty accurate projections for every area. The maintenance hour-consuming items were broken into five groups (Table 1):

1. Mandatory weekly maintenance.
2. Mandatory periodic maintenance, weekly average.
3. Mandatory emergency and/or project maintenance, weekly average.
4. Preparation and break time hours, weekly average.
5. Benefit hours, weekly average.

The next step was to split the operation into two basic time periods — daylight savings time (30 weeks) and standard time (22 weeks) — to allow for the variance in required maintenance during these periods.

TO ARRIVE at the numbers in Table 1, a time/task analysis sheet (Tables 2, 3, and 4) was devised for required weekly maintenance, additional required maintenance, and required emergency and project maintenance. You will also note in Table 1 the daily work preparation and break time amounted to nearly two full-time employees per week. While these hours may not relate to the hours on the course, it provides a good outline for approaching the board, green committee, or ownership concerning the needs of your particular situation.

TABLE 3
Time/Task Analysis — Additional Required Maintenance

	Hours	Apr./ Oct. No. of Times	Hour Total	Nov./ Mar. No. of Times	Hour Total	Explanation
Green verticut	3	15	45	5	15	1 man/3 hours
Green topdress	8	10	80	5	40	2 men/4 hours
Trim apron/verticut	8	7	56	3	24	1 man/8 hours
Green aerification	268	3	804	1	268	See below
Tee aerification	84	2	168	2	168	3 men/4 days
Fairway aerification	140	2	280	1	140	4 men/5 days
Fairway verticut	7	10	70	1	7	1 man/7 hours
Trap edging	180	4	720	2	360	6 men × 6 hours × 5 days
Weedeaters	80	4	400	2	160	4 men × 4 hours × 5 days
Green edging	80	7	560	3	240	4 men × 4 hours × 5 days
Tee fertilization	4	4	16	5	20	1 man/4 hours
Green fertilization	4	7	28	5	20	1 man/4 hours
Fairway fertilization	8	2	16	2	16	2 men/4 hours
Rough fertilization	8	2	16	2	16	2 men/4 hours
Rough aerification	21	2	42	1	21	1 man/3 days
Edge plaques	4	7	28	2	8	1 man/4 hours
Course flower beds	28	2	56	1	28	2 men/2 days
Load dumpster	1	28	28	20	20	1 man/1 hour 4×/month
RTC court squeegee	4			10	40	2 men/2 hours 10×/year
			3,413		1,611	

Green aerification — 2 men × 3½ days = 49
Clean plugs — 2 men × 3½ days = 49
Topdress — 8 men × 1 hour per green × 20 = 160
Seed amendments — .5 hour per green × 20 = 10
TOTAL: 268

After deciding what must be done, how long it takes, and how often it must be done, it is simple to determine whether or not the maintenance department is staffed to handle the expected maintenance effectively. In this particular case, the course was operating at a deficit level of five employees per week from April through October. What does it mean when you are operating with a regular deficit in man-hours? It means that you must constantly adjust and choose which maintenance procedures to omit periodically or regularly. The result is a situation where the nuances of quality begin to disappear. In other words, every area listed directly affects the quality of day-to-day playing conditions. Shaggy turf, partially raked bunkers, unswept areas, unfilled divots, puffy fairway and tee surfaces, leaky sprinklers, inconsistent rough, and weed encroachment are the result of deficit maintenance. Sooner or later, maintenance is performed in each of these areas, but not with consistent frequency, which is directly related to consistent quality or the lack of it.

It is not the intention of this article to have the golf course superintendent immediately begin pounding on the doors of our managers or green committee chairmen demanding more staff members. It is recommended, however, that you take a hard look at your operations, and accurately assess labor needs based on historically acceptable levels of maintenance. Before we can upgrade our operations, we must be able to accurately communicate our needs to our employers. If we can accurately quantify the labor hours required for maintenance procedures, we can legitimately request additional staff when we are required to perform additional maintenance.

TABLE 4
Time/Task Analysis — Required Emergency/Project Maintenance

	Hours	Apr./Oct. No. of Times	Hour Total	Nov./Mar. No. of Times	Hour Total	Explanation
Mainline repair	28	7	196	4	112	2 men × 2 days
Grade road	4	7	28	5	20	1 man/4 hours
Branch clean-up	4	7	28	5	20	2 men/2 hours
Tree clean-up	28			1	28	4 men/2 days
Tree planting	8	2	16	1	8	2 men/4 hours
Trap renovation	140	1	140			4 men × 1 week
Painting	147			1	147	4 men × 1 week+
In-house construction	105	1				See below
Drainage	140	1	140	1	140	4 men × 2 weeks per year
Herbicide	105	1	105			1 man/3 weeks
Rough seeding	35	1	35			1 man/1 week
Cart path program	315	1	315			See below
Apron scalping	84	1	84			2 men/6 days
O. B. maintenance	42			1	42	2 men × 3 days
Sodding	140	1	140			4 men/1 week
Brush clearance	280	1	280			4 men × 2 weeks
			1,507		517	

Cart path program — Remove asphalt and grade — 1 man/3 weeks
Add soil to edges — 2 men/1 week
Seed sod — 2 men/2 weeks
Total: 315 hours

In-house construction — Tees — 1 man × 3 weeks = 105
Brush clearance — 4 men × 2 weeks = 280
Starter house — 2 men/2 days = 28

Benefit hours — Sick pay — 8 hours × 5 days × 15 men = 600
Vacation — 8 hours × 10 days × 15 men = 1,200
Holiday — 8 hours × 7 days × 15 men = 840

2,640 per year = 51 hours per week

Building greens the right way helps keep the course beautiful.

Building Greens The Wrong Way Is Not Right

by JAMES F. MOORE
Director, Mid-Continent Region, USGA Green Section

ABOUT A YEAR and a half ago the GREEN SECTION RECORD carried the article "Building Greens The Right Way; It's Easier Than You Think." Tulsa Country Club superintendent Harold Neal described how his club took steps to insure five new greens were built exactly according to USGA Specifications. Unfortunately, this kind of dedication is not always practiced. Many memberships believe their greens are "Specification Greens," but after close investigation, they often find the construction procedure was modified by someone in some manner. The modifications most frequently include:

1. The deletion of the two-inch coarse sand layer.

2. Deletion of the four-inch gravel base.

3. Deletion of the fumigation process.

4. On-site mixing of the soil components.

5. Complete elimination or excessive spacing of the drain tile.

6. Improperly sized material, including excessive percentages of fine sand, silt, clay, or organic matter.

7. Improper organic matter that breaks down and forms nearly impervious barriers.

Recently the Turf Advisory Service visited a relatively new golf club in Colorado where the most-often-found modification — on-site mixing — has made the maintenance of good turf difficult, and at times impossible. On-site mixing is the most-often-made mistake concerning construction of USGA greens. It is easy to delude oneself and believe mixing materials on the green surface with a roto-tiller is just as good as off-site mixing with a soil blending process. It isn't true. Architects and contractors often mention cost savings to the club as the justification for on-site mixing. In reality, they should

(Above left) Each season, poor internal drainage made the greens very difficult to manage.

(Above right) Excavating revealed a rootzone that suggested on-site mixing — note the concentration of the organic matter in the upper six inches.

(Right) Profiles from different parts of the same green revealed totally different rootzones.

(Opposite page) Photos from nine years earlier proving on-site mixing was practiced.

be concerned with building the green properly, as specified.

There are significant agronomic disadvantages to on-site mixing. As most are aware, the key principle of the USGA green is the perched water table. Water will not move from the topmix into the underlying coarse sand layer and subsequently into the gravel drainage blanket below until each successive layer reaches field capacity (all available pore spaces filled). Once field capacity is reached, the drainage process begins, and excess moisture is drained from the root zone.

Obviously, any additional layers throughout the profile will create additional perched water tables and decrease the infiltration rate through the profile. It therefore becomes critical that the topmix is homogeneous throughout its depth.

On-site mixing cannot achieve this goal. An operator using a tiller must exercise great care not to allow the tiller to dig into the underlying coarse sand or gravel blanket. Compounding this difficulty, many contractors create undulations in a green with the topmix rather than with the subgrade. This leads to great variances in the depth of the mix. Not only does this adversely affect the movement of water through the profile, but also the tiller operator tends to keep the machine very high to avoid penetrating the shallow areas of the mix.

Before building a green, individual samples of the sand, soil, and organic matter that are to comprise the final topmix must be submitted to a soils laboratory for analysis. The lab will determine the percentage of each component necessary to achieve the time-tested USGA specifications. If the goal is an 85/15 ratio of sand to organic matter, the only way to achieve these proportions throughout the depth of the mix is to mix off-site. Even then, it is recommended that a sample, following mixing, be again submitted to the lab to insure proper proportions.

The accompanying photographs of the construction process at the Colorado golf course depict both the on-site mixing and the results that occurred a few years later. In this case, combining on-site mixing with sand that exceeds USGA percentages of very fine sand, silt, and clay has resulted in greens that simply will not drain. Tests by Agri-Systems of Texas laboratory revealed that the infiltration rate was practically zero. The very expensive process of building these greens will have to be repeated before they will provide the type of putting surface one should expect throughout the season.

On-site mixing is neither a money saver nor a budget buster. It really proves tremendously expensive if it becomes necessary to rebuild all the greens after just a season or two. If you are the superintendent at such a course, the expense may be the least of your worries. As Harold Neal's article indicates, building greens the right way *is* easier than you think. It is best for your club and your program. Building greens the wrong way is dangerous to your reputation. There is an old saying concerning airplanes: "If it's flying right, don't run out and try to fix it." It applies to building greens as well. The USGA specifications have stood the test of time. Why gamble with someone else's modifications?

TURF TWISTERS

HOTLINE

Question: Does the Green Section have a hotline for information regarding a serious chemical spill on the golf course? We had such a spill recently and received conflicting recommendations from a chemical expert and a university. I don't want to do anything to my turf until I speak with a USGA agronomist. (Tennessee)

Answer: Your best hotline is a call to the Green Section Regional Office for your area. Your county agricultural extension service office or the consumer information service of the chemical company that manufactured the spilled chemical should also be helpful sources of information. At this time, the Green Section does not have a central hotline, but consideration is being given to the establishment of this type of emergency information through the USGA Green Section's Turfgrass Research Computer Library, at Michigan State University. We will keep you posted.

ALERT!

Question: Has the USGA Green Section made any effort to alert member clubs about their responsibilities regarding runoff from chemicals or from the care and maintenance of machinery? It seems to me this is an area that should be addressed quickly. (New Jersey)

Answer: A number of articles have been published in the GREEN SECTION RECORD on this subject in recent years. "Planning The Golf Course Maintenance Facility," May/June 1987, discussed and illustrated the importance of equipment wash stands and wash facilities. "Pesticides — Changing An Image" appeared in the January/February 1986 issue, with a follow-up in the July/August issue. "Another Pesticide Problem — Local Laws" was published in September/October 1985.

There is increasing interest on the part of the general public in this subject. Golf clubs do have a responsibility, and they must constantly guard against pollution. More articles on this subject will appear in future issues.

FOR PESTICIDE APPLICATIONS

Question: We note increased awareness of our pesticide use by our neighbors as well as employees. What minimum records should be kept in case some legal action might be taken in the future? (Nebraska)

Answer: Records are cheap insurance, so don't worry about minimum requirements. Always write down:

1. Target pest.
2. Pesticide formulation, rate, and method of application.
3. Time and date of application.
4. Weather conditions at the time: temperature, relative humidity, wind speed and direction.
5. Names of employees involved and the protective equipment/clothing they use.