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Cover Photo:
To prevent seed from tracking off the putting surface, the crew at Martin Downs Country Club park the utility vehicle next to the green and never walk off the greens during seeding operations.

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Overseeding bermudagrass greens is a typical fall activity in preparing greens for the winter (Martin Downs Country Club, Palm City, Florida).

Overseeding: It Is A Challenge!

by CHUCK GAST
Agronomist, Florida Region, USGA Green Section

ANY WAY you look at it, maintaining consistent, top-quality turf conditions on bermudagrass-based greens in the South during the busy winter season can be a difficult proposition. Furthermore, regardless of the many factors analyzed and the educated decisions made, it's still a gamble, since weather is the most important and unpredictable factor and will ultimately determine the level of success achieved.

Throughout the South the number of golfers per day on many courses increases to as many as 250-300 during the winter season, when "Snow Birds" flock south. This presents a real challenge to the golf course superintendent, who must maintain consistently good-quality putting surfaces for the enjoyment of the golfers and the financial success of the club or course.

To maintain a good level of putting quality on bermudagrass greens during the winter, overseeding programs typically are performed. This doesn't mean, however, that good-quality winter putting conditions cannot be maintained on non-overseeded bermudagrass. To the contrary, the bermudagrass cultivar Tifdwarf, with proper management, has the ability to produce excellent year-round putting quality in the southernmost coastal regions of the United States. That's another story, however. This article is dedicated to the practices and programs associated with the overseeding of bermudagrass greens.

Why Overseed?

In deciding whether or not to overseed bermudagrass greens, several factors must be

Table 1
Approximate Number of Seeds Per Pound

Ryegrass	250,000
Bentgrass	6.1 million
Poa trivialis	2.3 million

Table 2
Recommended Seeding Rates

Monostands	**Pounds per 1,000 Square Feet**
Perennial Ryegrass	26-32
Poa trivialis	10-12
Bentgrass	3-5
Polystands*	
85% Perennial Ryegrass 15% *Poa trivialis*	25-30
80% *Poa trivialis* 20% Bentgrass	8-10

*Percentages are by seed weight

taken into consideration. First and foremost is the geographical location of the course and the anticipated length of time the bermudagrass will be dormant or inactively growing. Naturally, areas further north or inland in the Southern Region are more likely to engage in overseeding programs. The ability to maintain good winter color and to provide resistance to excessive turf wear will be major considerations in the decision-making process. After these factors are weighed and the decision is made to engage in an overseeding program, the following information should be helpful in improving the odds for success.

Seeding Alternatives

Three cool-season turfgrass species dominate the selections used in overseeding southern golf course greens. They include improved perennial ryegrass cultivars, rough bluegrass (*Poa trivialis*), and creeping bentgrasses. Several factors are involved in determining which grass or combination of grasses is the best for a particular course. They include:

- wear tolerance
- color
- texture
- height of cut
- spring transition
- compatibility of blends
- seed availability

In many situations the standard overseeding program consisting of a blend of three or four improved perennial ryegrass cultivars is the selection of choice. Ryegrass exhibits far greater wear tolerance than *Poa trivialis* and bentgrass, making it a good choice for courses anticipating intense play conditions throughout the winter season. Turf-type ryegrass also provides a dark green color, but tends to produce a slow putting surface during the fall establishment period when it is growing quickly and when elevated mowing heights must be practiced to ensure good turf establishment.

Poa trivialis has gained popularity over the years as an overseeding alternative. This turf species provides excellent putting characteristics and germinates and establishes quickly during the fall, thereby minimizing disruption to play. *Poa trivialis* is less tolerant of traffic compared to other species and therefore should be used only as a monostand overseed turf cover on courses that anticipate limited winter play. Ease of spring transition also can be expected with *Poa trivialis*, which has poor heat tolerance and therefore will not compete with the bermudagrass as late spring temperatures rise.

Overseeding with bentgrass also provides excellent winter putting characteristics on bermudagrass-based greens. The improved bentgrass varieties, however, possess good heat and drought tolerance and therefore should be used with caution in the central and northern sections of the Southern Region to avoid spring transition problems.

Many superintendents have found that utilizing ryegrass or bentgrass in combination with *Poa trivialis* provides better overseeding results and therefore more and more overseeding programs are moving in this direction. Reduced seeding rates of bentgrass and ryegrass and easier transition programs can be realized when *Poa trivialis* is included in the overseeding mixture. (See Table 2.)

Timing Considerations

Whichever seeding option you choose, proper timing of seed application is critical in determining the level of success achieved with the overseeding program. Tables that outline approximate seeding dates are available from seed suppliers, but the best indicator to determine the optimum time to overseed is soil temperature. Research has determined that the preferred soil temperature range for winter overseeding is between 72 and 78 degrees Fahrenheit at a depth of 4 inches.

Unfortunately, timing of overseeding programs often is dictated more by politics and economics than by good principles and agronomic practices. Overseeding programs often must be scheduled so as not to interfere with tournaments or to inconvenience members returning to their wintering grounds. Open communication and proper planning are critical to ensure that the best possible overseeding results are achieved.

Surface Preparations

Specific turf management practices should be performed well in advance to ensure optimum results when overseeding. Fall aerification of greens should be performed not later than 30 days prior to the proposed overseeding date. This allows sufficient time to achieve complete recovery from this operation and reduces the potential for

spotted surface conditions that can occur when overseeded grasses concentrate and germinate in aerification holes. Fall aerification is essential to reduce soil compaction, increase oxygen content within the upper root zone, and assist in reducing excess thatch, thereby better preparing the greens for overseeding.

The last application of nitrogen also should be made at this time to allow the normal slowing of bermudagrass shoot growth as fall temperatures begin to decline. This will be helpful in reducing bermudagrass competition with the newly germinating cool-season turf. Fertilization of the bermudagrass at this time also will be helpful to enhance the winter hardening process by promoting storage of essential carbohydrates for healthier bermudagrass plants next spring. Mid to late fall applications of potassium also are essential to assist in this hardening process.

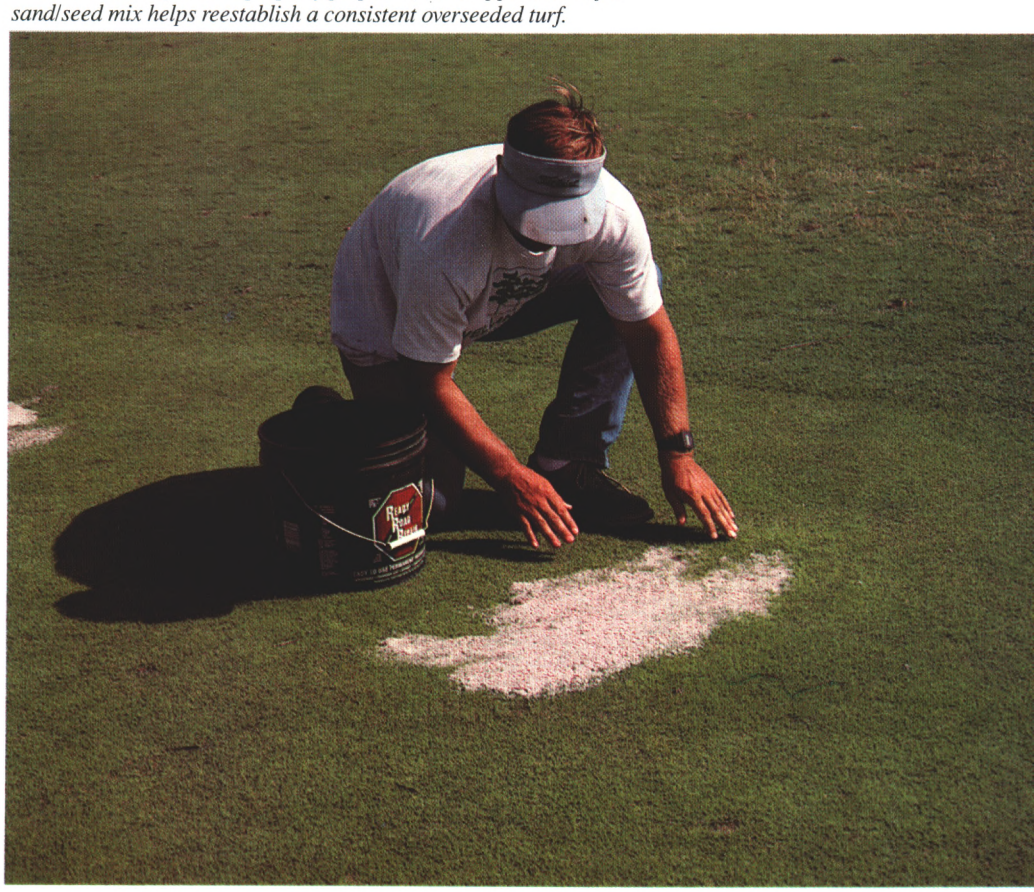
Implementation of a plan to control annual bluegrass (*Poa annua*) should be performed well in advance of overseeding. Good results have been reported with the use of fenarimol (Rubigan) as a pre-emergent herbicide to control annual bluegrass in winter overseeded turf. The three-application program, as per label recommendations, has provided good results, especially when overseeding with *Poa trivialis* or bentgrass. Timing is critical in the use of this product. To obtain optimum results, the last application should be made at least two weeks prior to overseeding with ryegrass and at least four weeks before overseeding with *Poa trivialis* or bentgrass. It also is suggested that when applying Rubigan in a multiple application program, special care should be taken to vary spray patterns across the greens to ensure uniform applications. If the same direction of travel is used each time, problems associated with potential 5-6× rates in the overlap areas may result.

Use of pronamide (Kerb) also has been reported to be effective in reducing *Poa annua* problems associated with overseeding. Application of this material should be made 45 to 60 days prior to overseeding.

On courses where the collars and approaches to the greens are not scheduled for overseeding, it is recommended that an appropriate pre-emergent herbicide be applied to these areas approximately 7-10 days prior to overseeding. This will be helpful to maintain clean surrounds and eliminate undesirable germination of seed that may be tracked off the greens by foot traffic or machines. Immediately prior to overseeding, a band of charcoal can be applied around the outer edge of the greens at a rate of 6-8 pounds per 1,000 square feet to inactivate herbicide overspray in these areas and ensure uniformity of seed germination.

An old groomer reel on a rotary mower handle effectively prepares isolated thin turf areas for additional seeding.

Once the thin turf area is properly prepared, hand application of a sand/seed mix helps reestablish a consistent overseeded turf.



Overseeding Procedures

In reviewing overseeding techniques, it is clear that many different methods can be utilized in completing overseeding programs. There are, however, a few common denominators that have proven beneficial in establishing overseeded turf.

Four to five days prior to overseeding, the height of cut on the greens should be raised to the range of 7/32 to 5/16 of an inch. This higher cut is helpful in creating a good seedbed and minimizing the chance of seed movement in case heavy rainfall occurs soon after seed application.

Light vertical mowing also should be performed during this time to open up the dense turf to promote good seed/soil contact for optimum germination and seedling establishment. Vertical mowing in several directions prior to overseeding promotes uniform seed establishment across the surface of these greens. Debris from the vertical mowing should be removed by blowers, vacuums, or greens mowing equipment.

In preparing the surface for overseeding, some superintendents also find it helpful to spike the greens in several directions to further improve seed germination and establishment. Spiking can be beneficial on greens that have a tendency to hold excess water in the upper root zone or on greens where the presence of surface algae would inhibit good seed establishment.

Uniform application of seed is a critical step in producing consistent winter putting quality, and several innovative methods have been developed by superintendents in their desire to achieve the best results. For example, Milorganite has been used as a carrier for uniform seed application when small quantities of seed are sown. Also, drop spreaders equipped with spray can attachments on either side assist in clearly outlining where seed has been placed. Another innovation involves the use of rotary spreaders outfitted with small chains attached to poles extending to the outer throw of the spreader to define the seeded area.

An outstanding method of achieving accurate seed application was developed by David Oliver, superintendent at the Martin Downs Country Club in Florida. His method involves topdressing the green prior to seeding with approximately 0.3 to 0.5 cubic yards of sand per 1,000 square feet. With the sand in place, the wheel tracks of drop spreaders can be easily seen to ensure uniform application. In this situation, seeding at half rates in two directions at 90° angles can be performed accurately.

To reduce accidental distribution of seed off the surface of the green due to worn spreaders or crew members' shoes, special care should be taken when parking utility vehicles during seeding. Park the utility vehicles immediately adjacent to the putting green surface and instruct workers to enter and exit the vehicle only on the side adjacent to the green. Furthermore, seed spreaders should be lifted from the vehicle directly onto the green so that travel off the green is eliminated. Practicing these steps will reduce the undesirable introduction of seed into areas where it is not intended to be placed.

Following topdressing and seeding, a carpeted dragmat or brush should be used to smooth and work the sand/seed mixture into the putting surface. Care should be taken during this operation not to drag the seed out past the intended boundaries of the green.

Tips for Optimum Seed Establishment

At the time of planting, the greens should receive a starter fertilizer with a ratio of nitrogen, phosphorus, and potassium in the 1-2-1 or 1-2-2 range. Phosphorus should be supplied at approximately 0.5 to 0.75 pounds per 1,000 square feet, as this essential nutrient is vital to good seedling growth.

To promote good seed establishment at this critical time, soil moisture conditions should be maintained at optimum levels without creating localized dry spots or overwet conditions. The surface of the overseeded greens should be kept uniformly and consistently moist during the initial two-week germination and establishment period. Manual irrigation may be needed during the early stages to minimize undesirable lateral seed movement.

Naturally, scouting for disease takes priority at this time as well. A preventative fungicide program should be scheduled to minimize disease outbreaks. Furthermore, it is suggested to utilize a fungicide-treated seed to prevent "damping off" during the critical seed germination stage.

Usually, a major issue during the first month following overseeding is the height of cut. To promote optimum seedling establishment at this critical time, heights of cut in the range of 7/32 to 5/16 of an inch are recommended. Maintaining these heights of cut for at least four to six weeks is essential to encourage deep root development for an overall healthier overseeded turf. Be sure to maintain razor-sharp mowers at this time and, if possible, mow when the surface of the green is dry to minimize damaging or pulling out the immature grass seedlings. It should be understood, however, that when utilizing perennial ryegrass as the predominant overseeded turf, its rapid growth rate during the initial two to three weeks of establishment gives the appearance that a much higher height of cut is being maintained. Stick to the program. If a lower height of cut is used for the sake of green speed, problems may be encountered in achieving good turf establishment. If the issue is a major one, try mowing twice per day to maintain peace. Once the overseeded turf has become well established, gradual lowering of the height of cut can be performed to achieve the desired speed and play characteristics of the overseeded greens.

Maintaining Optimum Putting Quality During the Season

Cutting height always seems to be at the forefront on this issue as well. As mentioned previously, cutting height should not be compromised during initial establishment. Once the turf is established, however, mowing heights in the range of 5/32 to 3/16 of an inch can be maintained during this relatively cool period. On well-constructed greens with minimal play, mowing heights as low as 1/8 inch have been practiced with success. Mowing overseeded bermudagrass turf at this low level, however, should be done only for short periods of time and should be limited to Tifdwarf-based greens overseeded with bent or a combination of bent and *Poa trivialis* in the southernmost regions of the country. It cannot be overemphasized that practicing these extremely low heights of cut places a significant amount of stress on both the overseeded grass and the base bermudagrass as well.

Instead of reducing the mowing height to achieve the desired putting characteristics, surface grooming, light topdressing, or rolling can be used. Very light vertical mowing or, preferably, occasional grooming in conjunction with routine mowing is an excellent method to produce good winter putting characteristics. Use of groomers during regular mowing is an efficient method to promote upright growth and smooth ball roll.

Light topdressing every four to six weeks during the winter season also is effective in producing desirable putting characteristics on overseeded greens. The use of approximately 0.1 to 0.3 cubic yards per 1,000 square feet is recommended. When uniformly applied and lightly brushed in, golfers won't be inconvenienced, but putting quality will be improved.

Should high-traffic areas begin to exhibit a loss of turf density during the height of the season, corrective measures should be taken. If these thin areas persist, problems with algae formation on the surface of the greens most likely will be encountered.

To promote turf recovery in high-traffic areas and minimize the development of algae, practices such as spiking, ¼" solid-tine aerification, or water injection cultivation should be performed. Spiking works

To ensure seed-to-soil contact, the bermudagrass must be adequately renovated prior to seeding. Here, a Lely dethatcher is used at Augusta National G.C., Augusta, Georgia.

well when thinning is minor, but in areas where significant turf thinning is occurring from intense traffic and over-wet soil conditions, solid-tine aerification is recommended.

Water injection aerification is a good tool to provide improved oxygen infiltration deep within the profile, and due to its method of operation there is very little disruption to the surface of the turf. In fact, any of these three cultural practices can be performed whenever necessary, with little or no inconvenience to the golfer.

To further assist in the rapid recovery of turf density in isolated problem areas, supplemental seeding also is suggested. Hand application of a sand/seed mix immediately following light surface preparation is advantageous in facilitating turf recovery.

A very effective method of preparing isolated thin areas for seeding was developed by Bill Henderson at the Wellington Country Club. His staff makes use of an old groomer reel attached to a rotary mower handle to prepare the surface. No heavy equipment is needed, and this procedure can be performed effectively by one crew member.

Tips for a Smooth Transition

Now that you've made it successfully through another busy winter play season, your work continues. All the procedures carefully executed over the past five to six months to maintain a good overseeded turf cover now must be somewhat reversed to facilitate a smooth transition back to the base bermudagrass. Following is a condensed list of procedures that will be helpful in your efforts to complete a smooth spring transition program.

The spring transition program is governed by soil temperatures, just as it was with fall overseeding. Soil temperatures should be monitored closely, and when the temperature of the root zone at a 4-inch depth stabilizes above 64 degrees Fahrenheit, the following spring transition practices should be initiated.

- Groom or lightly verticut one to two times per week
- Gradually lower the height of cut to approximately 5/32"
- Increase soluble nitrogen fertilization
- Maintain good soil moisture
- Initiate spring/summer aerification practices

The information contained in this article should be of benefit to help you succeed with future overseeding programs. Of all things discussed, remember that only one thing is certain: Mother Nature ultimately determines the outcome.

A USGA-SPONSORED RESEARCH PROJECT

Developments in Canada Goose Repellents

by **JOHN CUMMINGS**
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ROBERT WALKER/USGA

The development of a repellent would allow golf courses to reduce nuisance problems and turf damage caused by foraging Canada geese.

IN THE EARLY '60s, federal and state wildlife agencies began to implement strategies to increase Canada goose populations across the United States. According to the North American Waterfowl Management Plan, the goal was to have more than 2.9 million wintering Canada geese by the year 2000. The success of the Waterfowl Management Plan can be attributed to restoration projects where Canada goose goslings were released into certain locales to establish resident flocks. In addition, protective measures, such as hunting closures, predator-proof nesting structures, predator controls, and winter aeration of ponds and lakes to keep open water were implemented to help newly released geese. Canada goose populations responded favorably to these efforts, with recent estimates indicating more than 3.5 million wintering geese in the United States. Traditional migration routes and wintering areas changed with time. Today, Canada geese have adapted to a wide variety of habitats, including the urban environment, where they are termed "non-migratory residents."

While these population increases are an important step in the conservation of waterfowl, Canada geese also are implicated in habitat destruction, crop depredation, and safety and nuisance problems. Fifteen years ago, most golf course superintendents never would have dreamed that Canada geese would be grazing on greens, generating fecal obstacles, affecting water quality, chasing golfers, and generally playing havoc with the game of golf. Foraging urban and suburban geese damage grass in parks, backyards, and on golf courses. Feces left by geese reduce the aesthetic value and recreational use of these areas, and negatively impact water quality and public health. Geese also may pose a hazard to aircraft safety at airports. These concerns stimulated efforts to develop effective, economical, and environmentally safe repellents that deter grazing geese.

The development of a Canada goose repellent for use on agricultural crops and turf has become a top priority for researchers at the Denver Wildlife Research Center. In 1989, a research planning document was developed which had as a goal the registration of a repellent for waterfowl. The "Plan" outlined a systematic series of chemical screenings, laboratory tests, and field evaluations aimed at registration of a selected repellent with the Environmental Protection Agency (EPA). The project is now nearing completion thanks to support from the USGA.

Screening Potential Repellents

Two compounds, methyl anthranilate and DRC-156, were selected from a list of over 2,000 compounds that had been screened for bird repellency properties. The two compounds met criteria of being environmentally safe, effective, economical, and biodegradable. Methyl anthranilate is registered with the Food and Drug Administration as a flavor additive for human and animal foods. It occurs naturally in citrus and has the smell of concord grapes. In its technical state, methyl anthranilate will volatilize in less than 30 hours. To increase its longevity, a special recall designed encapsulation system holds the repellent until it is triggered by grazing geese. At concentrations between 0.5% and 1.5%, it is repellent to most bird species, including waterfowl. DRC-156, at a concentration of 1.0%, also is repellent to birds. This repellent causes a slight post-ingestional sickness (stomach-ache) that seems to trigger food aversion learning in birds that ingest the material with a food product. In the case of Canada geese, after experiencing the repellent they are able to distinguish the difference between treated and untreated sites, thus avoiding treated areas.

Laboratory and Enclosure Testing

From 1990 to 1992, various formulations, concentrations, and application rates of methyl anthranilate and DRC-156 were systematically tested on a laboratory diet (whole kernel corn) and grass that was exposed to geese. Initial feeding tests with methyl anthranilate at 1% and 2% concen-

trations indicated that Canada goose consumption of treated food (whole kernel corn) was reduced by over 90%. DRC-156 showed similar results. The significant goose avoidance of treated food at low concentrations and the consistent avoidance throughout the period warranted further testing of these repellents on actual grass plots.

A series of enclosure tests was conducted. The enclosure allowed replicated testing of goose repellents on 12 Kentucky bluegrass plots measuring 40 × 40 feet with fixed numbers of geese. It also allowed the evaluation of such factors as irrigation and mowing on the effectiveness and longevity of a potential repellent. Methyl anthranilate and DRC-156 continued to show promising results when tested in the enclosure. Application rates of 4, 8, and 16 pounds per acre were evaluated for both repellents. Methyl anthranilate applied at 8 pounds per acre or higher was effective in causing geese to completely avoid treated grass plots; however, the repellency of methyl anthranilate showed signs of decreased effectiveness by 10 days after treatment.

In experiments with DRC-156, application rates of 8 pounds per acre and higher also were effective in reducing goose activity on treated grass plots. Furthermore, geese responded relatively fast to the treatment (i.e., complete avoidance of the site was observed in two days). Geese continued to avoid treated grass plots for 20 days. When geese were removed and new geese were introduced onto the same treated plots, repellency was maintained for an additional 20 days.

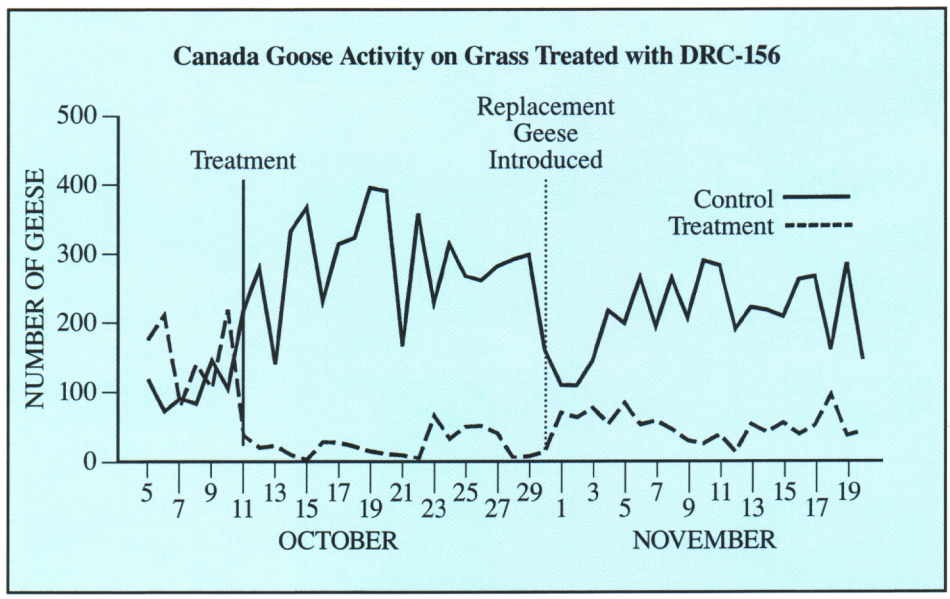
Field Testing

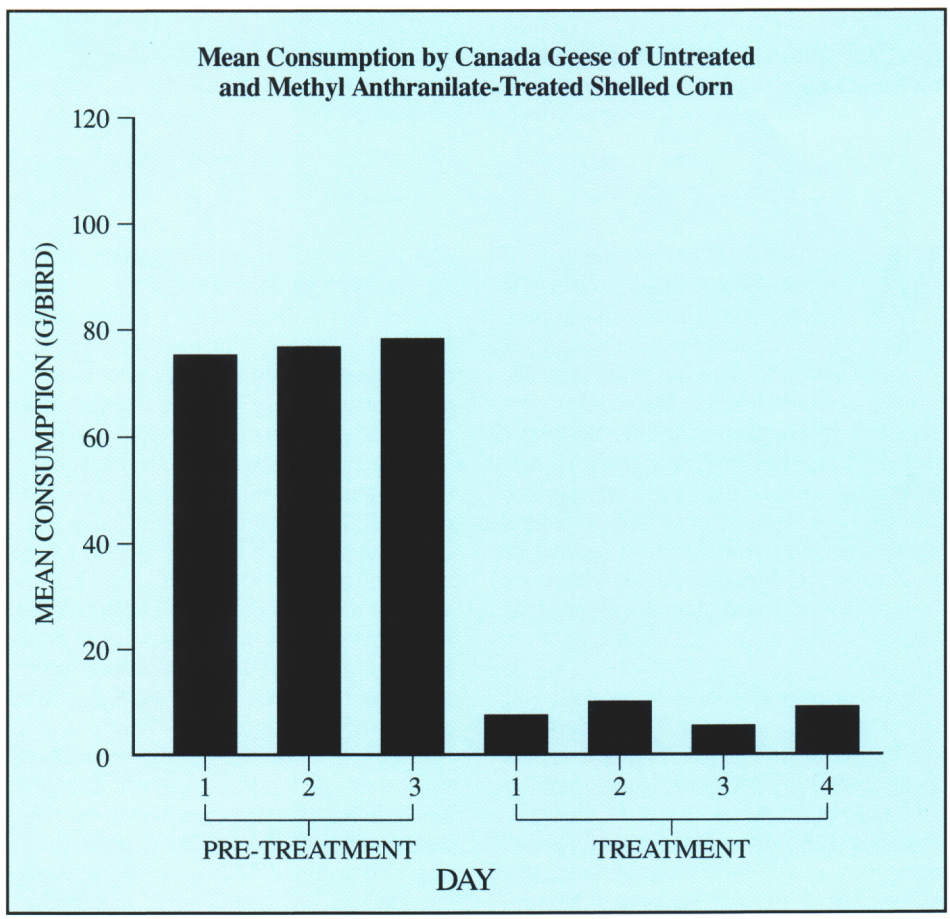
Resident and migratory flocks of Canada geese in the Denver, Colorado, metropolitan area cause nuisance and damage problems at several of the local courses for much of the golfing season. Rolling Hills, Foothills, Raccoon Creek, and Indian Tree golf courses were selected to evaluate DRC-156. The treatments were applied once at the rate of 8 pounds per acre during a 46-day test at the peak of the goose season. Data were collected on numbers of geese and the amount of feces present on greens and fairways. Grass samples also were collected at 5-day intervals to determine degradation rate of the repellent. Overall, goose counts and feces collections indicated that DRC-156 significantly reduced bird use of the treated areas at the four golf courses an average of 21 days. In the best case, geese at the Foothills Golf Club avoided treated areas for 39 days after treatment, and the numbers of geese using the golf course decreased dramatically. A new and improved methyl anthranilate formulation is scheduled for field testing in 1994.

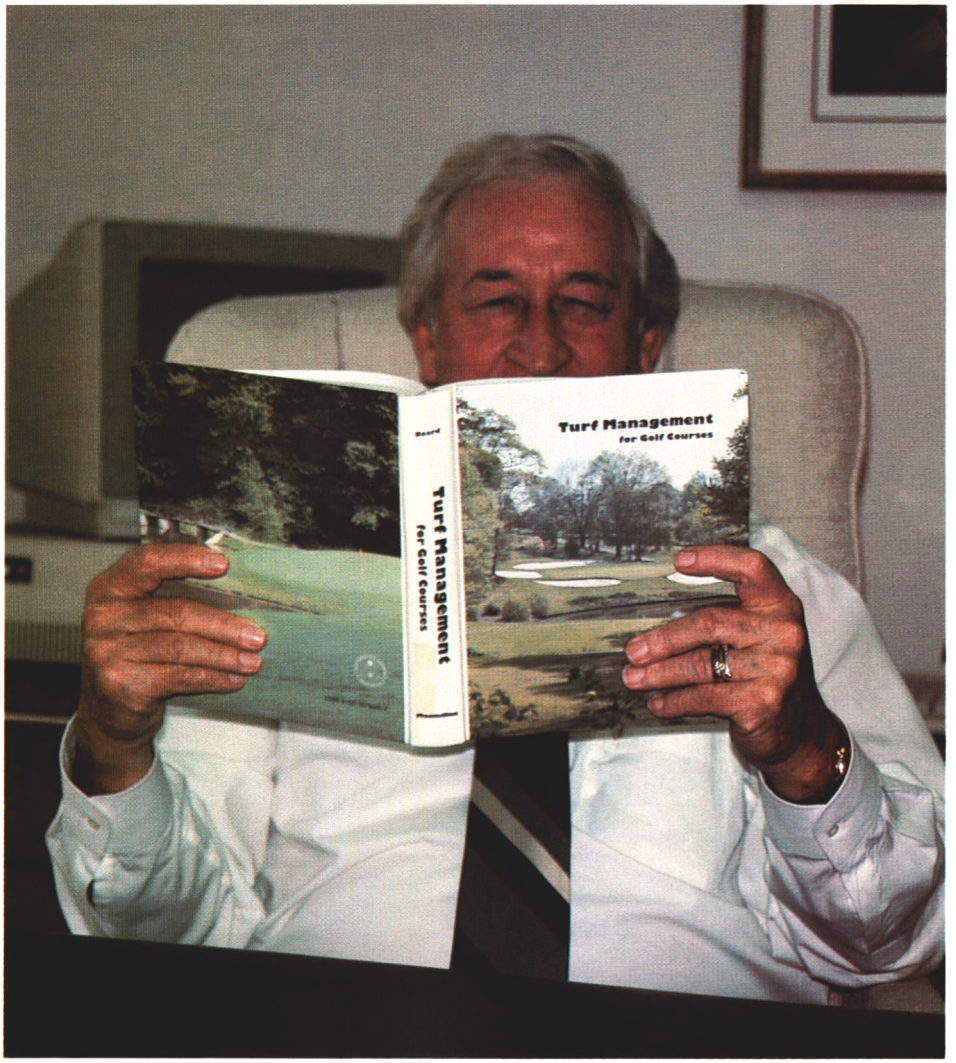
Conclusion

DRC-156, when registered with the EPA for use on golf courses, will offer golf course superintendents a practical solution to Canada goose problems. At a projected application cost of $20 per acre, DRC-156 would be cost effective for use at most golf courses experiencing goose problems. To date, initial data required by EPA for the technical product have been submitted for methyl anthranilate and DRC-156. It is hoped that both products will be available for commercial use within a year.

For more information about animal damage control, please contact the Denver Wildlife Research Center, APHIS Animal Damage Control, U.S. Department of Agriculture, P.O. Box 25266, Denver, CO 80225-0266.







It is not necessary for the club manager to be a turfgrass expert. A basic understanding of the maintenance operation and a good working relationship with the superintendent are the keys to success.

What Do Club Managers Need to Know About Golf Course Management?

by PATRICK GROSS
Agronomist, Western Region,
USGA Green Section

WE ARE LIVING in the age of information overload. In fact, it is getting next to impossible to keep up with all the current information within any particular field. This has led to specialization in many industries. The medical profession is an excellent example. No longer does one doctor treat all of our health care needs. Our children visit a pediatrician; we may make an appointment with a general practitioner who sends us to a radiologist for X-rays and then over to the laboratory for a blood test and then to an internal medicine specialist who refers us to a surgeon.

So what does this have to do with golf course management and the club manager? In addition to running the business affairs of the club, the manager must be familiar with the operation of the restaurant, pro shop, and golf course maintenance departments. Few people have the experience and background in all of these areas to be considered experts. That is why most clubs hire "specialists" for each department — chefs, golf professionals, and golf course superintendents. The question then becomes, how much does the club manager need to know about each of these areas so that the entire operation runs smoothly?

In the case of the golf course maintenance department, a basic understanding of the operation and pertinent maintenance practices is important. It is impractical to expect the club manager to be well versed in the specific areas of equipment maintenance, irrigation systems, turfgrass science, landscaping, soils and fertilizers, construction techniques, and pest control practices. After all, that is why you hire a professional golf course superintendent! It is important, however, that the club manager know how much involvement is necessary in these areas, and how to cultivate a good working relationship with the golf course superintendent.

The Basics

To understand the golf course maintenance operation, the club manager first must be familiar with the layout of the golf course. If the superintendent or a member starts talking about No. 4 green, the manager should know exactly which area is being discussed.

Next, it is important to understand seasonal changes that affect turf growth and playability and how these changes could possibly affect tournament schedules and maintenance activities. Snow, frost, heavy rains, or extreme heat can be expected during certain times of the year. These factors influence turf growth and often require adjustments to normal maintenance practices. Golfers may complain about not being able to use golf carts after a heavy rain. The manager should know that allowing cart use during such a time can cause extensive damage to the golf course.

Familiarity with golf course cultural programs should be another prerequisite for the club manager. What is core aeration? What is the difference between grooming and vertical mowing? Why do they put so much sand on the greens after aerification? A basic understanding of these programs will help the club manager respond to questions from golfers or the membership. Any specific questions or technical points always should be referred to the golf course superintendent.

Managers should understand golf course equipment requirements. It is not necessary to be well versed in the specifics of engine size and clipping frequency. Concentrate on the inventory requirements, the expected life span of the equipment and preparing to replace old equipment before large expenditures are required for repairs. Let's face it, many pieces of turf equipment cost more than a new automobile. The club manager can help the superintendent protect this large investment and justify the purchase of new equipment when necessary. This translates into improved course conditioning, less downtime and fewer repairs.

Finally, it is important to stay current on the laws and regulations that affect the operation of the golf course maintenance department. During the past 10 years, superintendents gradually have had to spend more time doing paperwork and less time out on the golf course. This is in response to ever-increasing government regulation. Issues such as worker safety, underground storage tanks, pesticide application, and effluent water use must be handled effectively by the club manager and superintendent to avoid injury or costly litigation.

Club Manager Involvement

There are some areas of the maintenance operation that require the involvement of the club manager — and there are those that do not. Where do you draw the line, and how involved should the manager become?

First, the superintendent should be in charge of all agronomic decisions: what types of fertilizers to buy, when they should be applied, specifying the types and models of equipment that should be purchased, irrigation scheduling, and other such decisions. The club has hired an expert to make these agronomic decisions, and he or she should be allowed to do so without interference.

There are other areas where the involvement of the club manager is critical. One of these is long-range planning. Managers should understand the need for special projects and routine maintenance practices such as core aeration. Coordinating these items with the tournament schedule and club events at least one year in advance will provide continuity for the entire operation. Many clubs have found it helpful to make contingency plans, such as alternate dates for aerification. Both the superintendent and manager should understand that it is impossible to plan for every occurrence. Emergencies are bound to happen at the most inopportune times, and it is important to remain flexible.

Most managers are involved with the budget and finances of the golf course maintenance department. The superintendent should keep the manager informed of all purchases and the need for large capital expenditures. This should be done within the purchasing guidelines of the club. Managers also should be aware of salespersons who approach them about golf course products without going through the superintendent. Oftentimes, these people are

Managers can help protect the club's large investment in turf equipment by understanding the inventory requirements and the need to replace old equipment in a timely manner.

Managers, as well as superintendents, need to stay current on the laws and regulations that affect the maintenance and operation of the golf course. This includes issues such as pesticide application, worker safety, and underground storage tanks.

selling questionable products, or "snake oils." Get the superintendent involved to help decide the merit of the product.

The Manager/Superintendent Relationship — Tips for Success

Getting along with people and personnel management are generally the most difficult parts of any job. Based on the comments and experiences of several managers and superintendents, there are several things you can do to cultivate a good working relationship.

1. Hold regular meetings and maintain an open-door policy. The upcoming calendar of events, long-range planning, and current information are topics that should be shared on a regular basis. Take the club manager on a regular tour of the course and point out the good things as well as the problem areas. This may be as simple as showing the manager the new piece of equipment that was purchased or what nematode damage looks like. If it is not possible to tour the course, the superintendent always should keep a photo journal of projects and occurrences on the golf course.

2. The manager should know how to handle complaints and filter comments about the golf course. Realize that no matter how good the course is, people are going to complain. It is important to get to the bottom of the issue and, if necessary, pass this information on to the superintendent. This will prevent relatively minor issues from being blown out of proportion and becoming fodder for the rumor mill.

3. Be honest and supportive in your dealings with each other. If you don't have the answer to a particular question, don't try to make one up. Promise to look into the matter and respond as soon as possible.

4. Attend an occasional seminar with the superintendent to gain a better understanding of current golf course maintenance issues. There are several opportunities each year, such as Green Section Regional Conferences, Cooperative Extension Seminars, and local superintendent association meetings.

While there are several steps you can take to cultivate a good working relationship, there also are things that can destroy that relationship. Here are a few things to avoid:

1. Gossip. Spreading rumors about the superintendent or club manager can lead to serious problems, particularly when mentioned to club members. For example, one manager casually mentioned that the superintendent was away from the course to attend a meeting and that the only reason he attends such meetings is to play golf. This was mentioned in jest; however, it got the entire membership up in arms and resulted in the superintendent being put on suspension.

2. Avoid surprises. As one superintendent described, "Don't make each other look stupid! Avoid awkward situations by keeping each other informed. It can be very embarrassing if a weekday tournament is scheduled on the same day as aerification."

3. Avoid "kingdom building." Everyone wants to feel that his or her department should have top priority. Realize that working together makes the entire organization look good.

4. Avoid the temptation of comparing your course too closely with other clubs. Often there are significant differences in the acreage that is maintained, microclimates, soils, budgets, and many other factors.

Summary

The club manager/superintendent relationship can be adversarial. Sharing information and learning some of the basics about the golf course maintenance operation can improve this important working relationship. Some club managers have been accused of "knowing just enough to be dangerous." With good communication and a willingness to try to understand each other's concerns, this situation can evolve into being one of "knowing just enough to be helpful."

GOLF COURSE CONSTRUCTION: GROW-IN PHILOSOPHIES

by TERRY BUCHEN, CGCS
Superintendent, Double Eagle Club, Galena, Ohio

ONE OF THE MOST specialized and least understood challenges ever faced by a golf course superintendent is overseeing the construction and subsequent grow-in of a new golf course. In this unique area of turfgrass management, there is a lot of art to go along with the science.

The Double Eagle Club in Galena, Ohio (north of Columbus), was designed by Jay Morrish and Tom Weiskopf. It was constructed by the Wadsworth Golf Construction Company of Plainfield, Illinois, using cool-season grasses. Double Eagle was grown-in during 1991 and opened for play in 1992. In the following article I would like to share some of the trials and tribulations of being an owner's representative and golf course superintendent at the Double Eagle Club, as well as discuss points experienced from the grow-in of 10 other golf courses.

Overview

It is safe to say that:

1. After the initial seeding and when the sprinklers are turned on for the first watering, the most critical time during grow-in is the *first three weeks!*

2. Growing-in newly planted turf will require *up to 10 times* more fertilization (for a limited period of time) than an existing golf course practicing routine maintenance.

3. Preventative fungicide applications should be applied at higher rates, with shorter intervals between applications, as recommended by the pesticide label.

4. The common goal of the owner, architect, contractor, and superintendent always is to grow-in the turf with minimal soil erosion as fast as agronomically possible. The grow-in budget usually is the determining factor.

Fairways

Penntrio creeping bentgrass was planted at 2 pounds pure live seed (PLS) per 1,000 square feet with a Brillion Turf-Maker Seeder. The soil physical analysis indicated a silt loam composition for the 6- to 8-inch depth of topsoil. Soil nutrient tests revealed deficiencies in N-P-K, a soil pH range of 6 to 7, and acceptable minor nutrient levels. Atrazine levels were checked, even though the property had not be farmed in eight years, and minimal amounts were detected. After experimenting with high rates of N-P-K during prior grow-ins, we decided to go with Scott's Pro-Turf fertilizer, a homogeneous product that is safe for young turf.

Grassing of the practice area early allowed the membership to hit balls while waiting for the course to open for initial play.

Our goals and concerns were:

1. A heavy pre-plant fertilizer application was needed because of the frequent irrigation cycles used. In addition, granular Subdue also was applied to control damping-off.

2. My experience has been that fertigation should be used only as a supplement to a granular fertilizer program, especially during periods of excessive rainfall and/or cool temperatures when the sprinklers are not used very often.

3. The heavy, granular pre-plant fertilizer application was sufficient to last for the *first three weeks*. After this period, the irrigation cycle was "backed off," allowing for additional granular applications to keep the grow-in proceeding at a fast pace. We then initiated a granular fertilizer program with a push-type rotary spreader. Once the turf was far enough along and the soil firm enough, a truckster/tractor-mounted spreader was used, usually after the three- to five-week period and beyond.

4. A second Subdue granular preventative fungicide application usually was made during the initial three-week period, using push-type rotary spreaders. The soil and turf were too soft and weak to allow any type of heavy spray equipment. All subsequent preventative spray applications were made with a walk-behind spray boom or truckster-mounted 100-gallon sprayer with a rear-mounted boom.

5. All sloped areas were straw mulched, with the material blown into place and then "crimped" in with tractor-drawn and push-type crimper implements.

The new turf was mowed with a lightweight triplex utility unit for the first few mowings, using solid rollers front and rear. Mowing was done in the afternoons *only*, and the clippings were not collected. After the first few mowings, a five-plex mower, with solid rollers front and rear, was used with the grass catchers. In catching the clippings early on, the golf course was kept firm, with a minimum amount of thatch present. In this case, a fairway topdressing program was initiated from the start. The solid rollers, both front and rear, were changed to the Whiele rollers as soon as the turf was knitted-in and matured enough.

In my opinion, one of the many "secrets" to a successful grow-in is the timing of the first mowing. Allow the grass blades to *"leaf-out"* to the two- to three-leaf stage before initiating the very first cut. If the new turf is cut too short on the first mowing, the new grass will be severely set back.

Roughs

Roughs were seeded with a blend of bluegrass, perennial ryegrass, and fine fescue at 4 pounds PLS per 1,000 square feet and fertilized similarly to the fairway program. No preventative fungicide program was needed. Seed germination was earlier than normal due to the extra nutrient boost, and the new turf was successfully established. Sod was used around all sand bunkers adjacent to fairways, greenside bunkers, one to five strips around each tee, and where needed around green banks. For easier access, the new sod, which closely matched the seed specs, was not initially mowed until three weeks after seeding when the water was backed off.

The roughs were fertilized and straw mulched similarly to the fairways, and the water was decreased at the same time. All new sod was mown with rotary mowers with grass catchers and then raked to collect extra clippings. Self-propelled rotaries were used until the seeded turf was sufficiently rooted to handle riding equipment.

Greens

The greens were seeded in two directions with a drop seeder using Pennlinks creeping bentgrass at 2 pounds PLS per 1,000 square feet. A riding sand bunker rake with knobby tires was driven over the surface to compact and firm the seedbed. The depressions from the tires help keep moisture in the soil longer and do not have any long-term effects on the smoothness of the green. The depressions flatten out over time from irrigation, rainfall, and the rolling action of the mowers, and they totally disappear after the first heavy topdressing. It is amazing how much seed germinates in the tire depressions!

The root zone mixture was 85% sand and 15% Canadian sphagnum peat moss. An intermediate layer was not needed after thorough testing of all subgrade materials. It is always a good idea to run a nutrient soil test of the root zone mix. Initial nutrient levels of the seedbed mixture indicated N-P-K levels were deficient and many minor nutrients also were low. Nutrient levels were initially corrected with Scott's STEP granular material, and another application was made during the 10th week after initial seeding.

Beginning with the third week, we used "The Sandwich" method of grow-in whereby the turf was topdressed each week to bring the turf level *up*, and the mowers were subsequently lowered each week to bring the turf level *down*.

The greens were much easier to fertilize in comparison with the fairways and roughs, as cart paths were nearby and the greens did not footprint appreciably because of the 15 inches per hour initial infiltration rate. Preventative fungicide applications were similar to the fairways, utilizing granular products for the first two applications.

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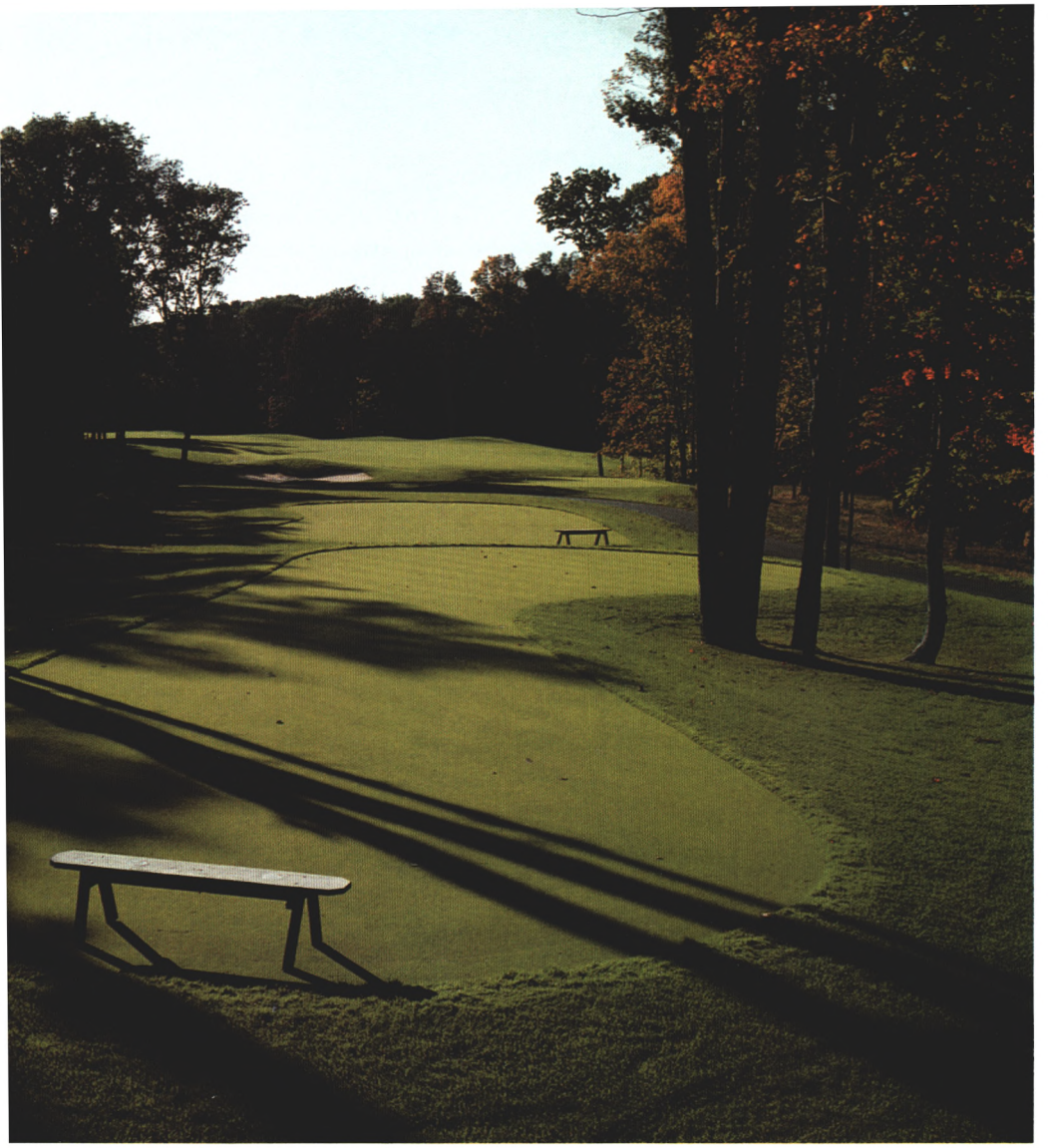
Tees

Penncross creeping bentgrass was seeded at 2 pounds PLS per 1,000 square feet similarly to the greens. The root zone mix was the same as the greens, but was at a depth of six inches. No subgrade gravel or drainage tile was used since the subsurface of the soil was sloped 2% to the rear. The root zone mix was graded perfectly level for what we felt were ideal playing conditions. [Editor's note: We sometimes see tees constructed with a slight front-to-back slope.) Fertilization, pesticide applications, and topdressing programs were similar to greens.

Some Thoughts for a Successful Grow-in

Fertilization

The first three weeks of heavy watering makes it very difficult to fertilize greens,



Even with the utmost in precautionary measures, some trees may die along golf holes for up to five years after initial construction.

tees, and especially fairways and roughs. Use a safe, homogeneous fertilizer product that is a proven winner and that you are *personally familar with*. You must know how it will release the major nutrients. Trying to test unfamiliar or unproven products during grow-in is very difficult and risky at best. Fertigation works as a supplement to granular fertilizers.

Keep the phosphorus and potassium levels high to promote top growth and root development and to help prevent disease. During the initial 10- to 12-week period, determine when to begin a routine maintenance fertilizer schedule. The heavy fertilizer applications during the rapid grow-in period can be overdone, causing excessive thatch. Micronutrients should be added during the initial seeding using a granular material to guard against excessive leaching, especially on sand-based greens and tees. (*Remember,* grow-in fertilization is just the opposite of routine maintenance!)

Fungicides

The initial fungicide application prior to turning on the sprinklers for the first time *must* be a *granular* systemic fungicide. In my opinion, using a liquid and spraying bare soil is not very effective. A second application of the same product should be made two to three weeks later, usually when the turf is well established and after decreasing the frequent irrigation cycles. All subsequent pesticide applications can be sprayed, as the turf usually can handle the weight and traffic of a 100-gallon truckster-mounted boom sprayer on the fairways and a walk-behind boom on greens and tees. Using treated grass seed does help, but the granular fungicide program must be used. This is the only product formulation that can withstand the frequent irrigation and lush turf growth.

Pythium/damping-off is the main disease of concern with the high fertilizer rates. I have always used my "gut feeling" regarding preventative broad-spectrum fungicide applications and have *never* used them until after the three- to four-week period. There never seems to be any reason to justify their use in the early stages of grass development. If you feel that a broad spectrum systemic/contact fungicide is needed, be careful. Some granular fungicides of this nature are not safe for use on newly planted turf.

Watering Practices

Watering only during the daylight hours works best. "Wake up the new turf with a drink in the morning, and put it to bed with water at dusk." This old saying is so very true. A good rule-of-thumb is to water every two to three hours with one to three turns of the sprinkler head during each cycle. The biggest mistakes made during grow-in are with watering practices, where the soil is not kept wet enough due to concerns about erosion. To properly water a new seedbed, a small amount of erosion usually occurs.

Once the seed is wet for the first time, *it cannot be allowed to dry out even for the shortest period of time.* It is best to water *only* with individual field controllers. One person should water semi-automatically on a few holes and watch for over-watering and under-watering, and turn off stuck sprinkler heads immediately. Except for initial testing, do not use the master irrigation controller for any type of watering during grow-in. A person must be there to properly monitor the soil and turf.

Irrigation System Testing

Flush and test each sprinkler and all piping for as long as is practical to help eliminate sprinkler head malfunctions. Most leaks and stuck sprinkler heads can be eliminated by flushing during installation and once again before grassing begins.

Mulching

The best results with grassing have been witnessed when fairways and roughs are mulched with hay or straw, depending on what is locally available, to keep the soil moist and to help guard against unnecessary soil erosion. The mulch should not be spread so thick that the new turf is smothered. It should be "tucked" in with a tractor and hand-operated devices. Talk to the local supplier about possible weed seed contamination in the straw; the cleaner, the better.

Preemergent Herbicides

Consider using Siduron preemergent herbicide, with a starter-type fertilizer as the carrier, on the bentgrass fairways. I have seen anywhere from fair to excellent results achieved for a two- to three-week period against weed seed germination. Do not be

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Proper fertilization, preventative fungicide applications, proper water cycles, and mulching of slopes are critical for a successful grow-in.

alarmed if annual weeds germinate after the Siduron wears off. The desired turf will be strong enough to compete against the weeds, and the weeds can be sprayed out easily after the turf is established.

Equipment

Again, stay with proven winners as it pertains to any equipment purchases for the grow-in. I always have purchased equipment I was personally familiar with because malfunctions can be disastrous. I have used "demos" of unfamiliar equipment, but it is difficult, at best, to spend much time evaluating the equipment. Grow-in is a very busy time.

Take extra precautions against the construction dust. Air filters on all equipment should be cleaned and checked many times throughout the day. Also, change engine oil frequently.

Mowing

For the first mowing, let the grass blades "leaf out" by letting the turf grow about 50% higher than the desired first mowing height. Always use solid rollers, front and rear, until the turf is established. The grass blades should be at least in the two- to three-leaf stage before the first cut is initiated. Grow-in is made particularly challenging by the many different mowing heights encountered at the same time as greens, tees, fairways, and roughs are in different stages of maturity. We label individual mowers with the machine's precise mowing height to avoid confusion and costly mistakes.

Seeding Rates

Use the pure live seed (PLS) method for all seeding rates: Purity × Germination = Pure Live Seed %. Divide the PLS figure into the desired seeding rate to determine the actual seeding rate needed for 100% PLS. Work with the contractor to double check all seeding rates and equipment calibrations. If a different type of seed is used with any seeding equipment, blow the seeders out with air to avoid undesired seed contamination.

Bunkers

Consider installing the bunker sand and sodding around the bunkers at the same time, just prior to seedbed preparation. Coordination of hand-watering the sod is important to properly water the newly sodded turf without washing soil into the newly placed bunker sand. For ease of irrigation, install a quick-coupler valve next to all areas that are going to be sodded. Algae may appear on the surface of the bunker sand during the first three weeks of watering, but will disappear after the irrigation cycles are reduced.

Drainage Grates

Sodding around drainage grates, both in the fairways and the roughs, is recommended. The addition of hay or straw bales or a silt fence is an extra precautionary measure to keep the drains from becoming "silted over" with eroded soil. Straw mulch placed away from the catch basins will further ensure better results.

Construction Progress

The last 5% of the construction phase is the busiest time. On average, up to one hole a day can be totally finished and turned over to the superintendent for his/her grow-in expertise. Have all equipment, materials, chemicals, and fertilizers on hand well before each hole is completed.

Teamwork

The owner, architect, contractor, and superintendent must all work as a team to achieve the desired objective — the opening of the new course. Leave your ego at home and communicate and help each other out during the busy times, especially during irrigation testing and subsequent grassing. Strive for a good, professional relationship *before* and *after* the construction is completed, and you will sleep better at night.

Summary

The fascination of the game of golf is that no two courses are alike. This holds true for building and growing-in a new golf course as well as playing the game. In this article I've attempted to detail a number of the techniques used to grow-in golf courses with which I have been associated. Obviously, there are other ways to do things. Nonetheless, I hope this article helps the turfgrass manager with one of the greatest and most rewarding challenges in our profession.

Does Construction Relate to Maintenance Costs?

Don't Underestimate Irrigation, Drainage, and Soil Systems

by RICKY J. KROEGER, CGCS
Director of Agronomy, Golfplan — The Ronald Fream Design Group, Ltd., Santa Rosa, California

ALL NEW golf course entrepreneurs recognize the necessity of completing construction of their golf course with a minimum of costs. Avoiding excessive construction costs leaves enough money to allow construction of a more elaborate clubhouse area or, better yet, to decrease the amount of investment necessary. Financial rewards go to developers who are prudent enough to build the best possible course at a reasonable price.

Through our professional involvement with investors/developers of more than 125 golf courses in over 50 countries spanning 20 years, we have seen projects completed with both a minimum of investment and an excess. While most have thrived, others have floundered after opening, in part due to excessive maintenance costs and poor-quality turf. At fault was a lack of appreciation of what it takes to keep golf course turf healthy, attractive, and playable for the customers who pay the bills.

Although opinions vary regarding the creative architectural strategies and artistic values that stimulate golfers to return over the life of a course, it should not be forgotten that few will return if the course is not green and playable. The three critical physical factors affecting cost-effective maintenance — soil, drainage, and irrigation — have interrelationships sufficient to confuse most investors/developers and many golf course operators. In fact, many course architects don't sufficiently understand the agronomic and hydrologic principles necessary to minimize operational expenses after construction. If the architect cannot explain (or the investor/developer

Drainage installation occurring 18 months after construction. Malaysia.

will not agree to provide) the necessary soil, drainage, and irrigation resources for a given course, there is a real likelihood of excessive maintenance costs in the future. Insufficient priority allocated to these three major factors creates additional annual expenditures that offset income. Rarely do the savings in initial investment justify the expense of fixing it later. It is always better to *build it right the first time!*

The best golf course architects have an extensive background in landscape architecture, civil engineering, agronomy, hydrology, and horticulture, combined with a solid knowledge of golf course maintenance. The unwitting investor/developer who retains a golf course architect because he has won several golf tournaments sometimes trades name recognition for excessive maintenance costs and weak design. Although a certain amount of initial play is attracted by the pro's name, players do not return if the turf is not attractive and playable or if the design is not enjoyable to players of all abilities. Soil, drainage, and irrigation problems, when built into the golf course, require the type of ongoing expenditure that few new courses can afford after opening.

When those responsible for the maintenance of the completed course find themselves reseeding and resodding the same areas over and over again, it becomes obvious to them that the problem is with the soil, drainage, or irrigation system. Looking back, it often is painfully clear that the solution could have been done during construction and at a minimal price. To rework an area after opening often requires triple the original cost investment, inevitable golfer inconvenience, and the loss of potential return customers. Cash flow drops as golfers decide to play elsewhere during the repair of the same mistake on each hole of the golf course.

It is no wonder that many of the owners of these courses choose instead to manage what they have, increase the maintenance budget, and hope for the best. Money that should have remained as profit instead gets put into maintenance.

The Soil

The best soils for the growth of turfgrasses are not always available on the site. It is prudent, then, to involve an architect who has a good agronomic background. Although most soils can be managed to adequately support golf turf, the expense of doing so can vary greatly. Careful consideration must be given to adapt the irrigation and drainage systems to the existing soils. These two factors strongly affect the day-to-day expense of course operations. While sand may drain well, it requires very uniform distribution of water by the sprinklers to avoid dry, brown, or dead areas. Clay, however, drains very poorly and requires very uniform distribution of water by the sprinklers to avoid wet areas.

Compaction of the soil during construction and use of the course after opening must be considered as significant factors that will affect the cost of maintenance. Compaction on a golf course is created when the weight of construction equipment, golfers, mowing equipment, golf carts, and water all combine to squeeze the air out of the soil. Water is the lubricant and weight is the force that packs the soil tightly together. When too much of this occurs, roots have no place to grow, drainage slows, the course stays wet longer after rainfall, and irrigation is plagued by wet and dry spots. As golfers play, and as maintenance equipment and golf carts are driven over these compacted areas, the entire situation gets much worse because there is now more water/lubricant available to promote additional compaction. In the end, the turf declines and affects playability. For golfers who continue to play the course, further inconvenience occurs as areas are disrupted for repair.

Compaction on new golf course greens has been greatly reduced since the advent of the USGA Method for Putting Green Construction. Now decades old since its first publication, and recently modified to increase options and reduce costs, this method is based on time-proven scientific principles. Once understood, these principles can be applied in situation after situation around the golf course.

This has been accomplished in many high-rainfall areas of the world. Resistance to compaction, good drainage, root zone moisture retention, acceptable nutrient retention, and ease of handling are important assets when seven feet of rainfall occur during the playing season! In these cases, we construct a sand/humus root zone mixture, which holds to these principles, over all of the greens, tees, fairways, and roughs. Imagine 38 hectares (95 acres) of a sand/humus mix 30 cm (12 inches) deep, with 20 kilometers (12.5 miles) of drain piping. At $5.00 per cubic meter (or cubic yard), the cost for the sand alone is $700,000! These savvy developers do it because they recognize the problems that the existing poorly drained clay would cause and the number of days the course would be closed because of waterlogged conditions.

Clearly, the impact of soil quality on the financial well-being of the golf course cannot be overestimated. Specialized expertise is necessary to assess the soil to provide a reasonably accurate estimate of the cost of maintaining a site following construction.

Drainage

Anyone involved in a golf course construction project should recognize that nature can intervene at the worst possible times during construction and establishment. The potential effects of wind and water must be

Golfe de Fregate, Bandol, France (before and after photos). While good soil is not always available, it always pays off to seek the expertise of a golf course agronomist. The best time to consider annual maintenance costs is during planning, not after construction.

given due consideration from the initial planning of the course in order to minimize the negative financial impact of which these forces are capable. Most important, the speed with which excess water is removed from the soil significantly affects the profitability of the project and its annual operation expenses.

One of our island golf courses in the Pacific Rim was recently subjected to a typhoon that dropped more than 25 cm (10 inches) of water in less than 12 hours. The typhoon occurred a few months after planting the course, just prior to opening. During planning and design, the owner approved the installation of a comprehensive drainage system that we designed as an alternative to importing tremendous quantities of soil. In communications after the storm, the owners quite happily informed us that the drainage system worked so well that the course could have been opened on the day following the storm.

Excess water is a foe capable of eroding profits. It causes courses to choose between closing to avoid damage or risking the expense of repairing the damage caused by players. Unfortunately, grass does not stop growing during wet periods — on the contrary, it grows all the more. Mowing equipment used at this time causes compaction, rutting, and the resulting loss of playability. Those who choose to avoid mowing during wet periods find themselves with dissatisfied golfers. Long grass is difficult to play from, and waiting to mow until the ground firms can cause scalping injury. Eventually, labor is diverted from routine maintenance to course repairs or drainage installation.

Drainage systems do not need to be expensive to work. They must, however, be well conceived and effectively built. Skimping on this vital element during construction eventually means either increasing the maintenance staff (with attendant increasing costs) or accepting lower standards of playability and risking loss of income.

Irrigation

The demand for irrigation water is directly influenced by soil texture, soil salinity, monthly rainfall, irrigation water quality, the total area to be irrigated, air temperature, relative humidity, and grass species. The architect of the course must consider all of these factors, as well as the source and availability of water throughout the year, when designing the total watered area.

The engineering involved in designing an irrigation system must take into account every square meter of irrigated area on the property. It starts at the water source and ends when the water leaving the sprinklers lands on the ground, uniformly distributed so as to minimize wet and dry areas. The quality of the installed system is often gauged by its ability to:

- operate efficiently given the skill of locally available labor
- evenly distribute water over the wide range of golf course conditions
- accept additional sprinklers in the future
- allow individual control of sprinklers in a specialized situation
- operate throughout the season with a minimum of repairs

Accomplishing these few objectives requires expertise and experience. Every deviation from prudent engineering increases both the daily maintenance and repair costs and potential golfer dissatisfaction due to inconvenience, lack of playability, and poor visual quality.

State-of-the-art irrigation equipment that is appropriate for the specific region may appear expensive, but it can pay for itself many times over. One such component is the fertilizer injector, which is used to inject liquid nutrients into the pipeline at the pumping station, eliminating the need for frequent trips across the course with tractors and spreaders. At a cost of $10,000 to $20,000, they pay for themselves within a few years through labor savings, reduction of equipment-related damage, and the shorter time period from turfgrass seeding/stolonizing to the opening of the course. Each irrigation system must be engineered to accommodate the specific labor conditions and level of worker/user sophistication in the local area.

Summary

It is imperative that the irrigation, drainage, and soil systems be integrated and carefully designed. As cost estimates are scrutinized to remove what may seem to be luxuries, extreme caution is in order. Typically, dollar-driven reductions in the irrigation, drainage, and soil systems erode future operational profits. The annual cost of maintenance necessary to overcome the effects of weaknesses in any of these elements is often greater than the initial savings generated.

The new golf course entrepreneur in the process of a pre-construction cost control review would do well to utilize an experienced agronomist or golf course superintendent before finalizing the construction budget. A lack of consideration for the soils involved, uniform water distribution, and adequate drainage will cause wet and dry areas to occur. These areas require triple the investment of time and money to repair after completion as compared with the cost of proper construction. Care must be taken to insure that future problems are not built into the course during the design and construction process!

ON COURSE WITH NATURE

Soil Bioengineering: A Natural Approach to Stream Bank Stabilization

by NANCY P. SADLON
Environmental Specialist, USGA Green Section

EVERY BODY of water is a dynamic system that undergoes change. A river or stream is constantly eroding and depositing materials, realigning its course. Land development and human activity have accelerated this normally slow process. Our land-use habits all contribute to increased volumes of stormwater runoff, sedimentation, excess nutrients, and other contaminants that displace or affect native plants, wildlife habitats, and organisms that otherwise help maintain stability and water quality.

Uncontrolled stream bank erosion results in excessive sediment deposits that degrade water quality and kill fish and other aquatic species. Unstable slopes and stream banks also result in a significant amount of land loss and structural failures of paths and bridges. Traditional solutions for correcting problems have been expensive, involving heavy construction options of rip-rap, concrete or rock walls, crib walls, or gabion structures. These traditional hard engineered solutions provide little benefit to fish and wildlife habitats.

Approaching erosion problems on the golf course with a restoration attitude and choosing to implement an alternative method known as soil bioengineering can result in cost savings, improved aesthetics, and the return of valuable native plant and wildlife habitat to waterways.

Soil Bioengineering Basics

Soil bioengineering involves the use of live, woody vegetative cuttings (usually dormant shrub branches) to repair banks and increase slope stability. The cuttings serve as primary structural components, aid in drainage, and act as barriers to earth movement. Woody plant materials most commonly used are willows and shrub dogwood, which characteristically are deep rooted and quick to establish.

As the branches take root and grow, the slope becomes more resistant to water flow. Over time, the stabilized plantings are colonized by native vegetation that helps blend the site with its surroundings and provide habitat for wildlife. How quickly the area becomes stabilized is dependent on the amount of effort put into the bioengineering.

The vegetative materials of the soil bioengineering method can be established alone or in combination with biodegradable textile fabrics. Common techniques for soil bioengineering plant placement are cuttings, rooted cuttings, wattles, or live fascines, brush layering, brush mattressing, live staking, and water-flow deflectors. Grasses and forbs are included primarily for protection from surface (water and wind) erosion, and also are helpful in providing soil stability. Soil bioengineering installation is labor intensive, but does not require highly skilled techniques.

Design Considerations

While the concept and implementation of soil bioengineering are simple, numerous considerations are important for project success, including:

- the ability of riparian plants to resist erosive flows
- site conditions and stream flow
- soils and stream sediments
- compatibility with structural treatments
- fish and wildlife habitat
- adapted plants by region and microclimate
- methods of establishment
- maintenance and protection of vegetation

Both small-scale and large-scale projects are suited to the bioengineering technique, providing long-term stability, aesthetics, and reduced costs.

For More Information and Assistance

Help in the analysis of specific golf course conditions is available through many federal and state agencies such as the Soil Conservation Service (SCS) of the United States Department of Agriculture and independent consulting groups. Since 1935, the SCS has provided free technical help to landowners to protect, develop, and wisely use our soil, water, and other natural resources. The federal Soil Conservation Service has state offices and numerous SCS conservation districts at the county level. The county and federal SCS offices work closely together to provide information and assistance on soil bioengineering, plant material selection, and other water quality questions.

Soil bioengineering is a solution worthy of consideration on every golf course that deals with soil erosion. It is a method that receives high marks for its environmental compatibility, and it provides a cost-effective, aesthetically pleasing way of protecting the multiple values of streams and other water bodies.

Case Study #1

Site: Peter's Brook, Somerville, NJ.
Technical Assistance:
1. USDA Soil Conservation Service, Bridgewater, NJ.

Live willow stakes can be utilized to correct erosion situations. Use of live woody plant cuttings to stabilize severe erosion problems is referred to as "bioengineering."

2. USDA Soil Conservation Service, NJ State Office.

3. NJ Resource Conservation & Development, Somerset County Engineers Office.

Problems: Increased stream flow peaks and sediment loads, combined with vegetation removal, caused over 120 feet of stream bank to erode, resulting in sediment pollution and loss of land area.

Background Information: New Jersey experiences 45" average rainfall per year. Soils at the project site include Rowland silt loam characterized as flood-plain soils. Peter's Brook hydrology characteristics include storm flows of 1,099 cubic feet per second (cfs) to 7,981 cfs, representing two-year and 100-year storms, respectively. Estimated bank-full stream flows are 400 cfs. Park area adjacent to the stream receives frequent flooding. Drainage area is characterized as urbanized and includes approximately 5,900 acres.

Solution: Hand crews and limited equipment restored the streambank using bank sloping in conjunction with the live fascine technique (long bundles of branch cuttings bound together like sausage). The cuttings technique (10" to 18" sections of dormant, ¼"-diameter willow stems) were also used in combination with organic erosion fabrics and biodegradable geotextile logs. A grass seed mixture of perennial ryegrass, creeping red fescue, and Kentucky bluegrass was used to stabilize stream banks. Bankers dwarf willow (*Salix x cotteti* Kerner), a fast-growing dense shrub, was used in addition to the grasses.

Costs: $15 per linear foot as compared to projected costs of $50 per linear foot for rip-rap.

The success of this project has resulted in plans for future bioengineering projects at Green Knoll Golf Course, located further upstream on Peter's Brook.

Case Study #2

Site: Canyon Creek, Billings, Montana.

Technical Assistance: Inter-Fluve, Inc., environmental consultants.

Problems: Poor soils and land use practices, increased stream flow peaks and sediment loads, combined with the removal of stream-side vegetation, caused over 4,000 feet of massive erosion.

Project Background Information: Climate at this project includes 15" average rainfall. Soils are Yellowstone River silts classified as highly erosive. Heavy irrigation demands on the creek resulted in significant water withdrawal from the stream. Hydrology characteristics involved significant fluctuations in stream flows from 10 cfs to 270 cfs. Bank-full stream flows were approximately 270 cfs. Stream bed features include large transport areas and depositional areas that affected the channel capacity. The drainage basin area is classified as agricultural and includes approximately 12,000 acres.

Solution: Heavy equipment and hand crews completed restoration by sloping stream banks to a stable angle, creating riparian vegetation, stabilizing stream channel and bed features, and applying biodegradable erosion fabrics. Blue grama (*Bouteloua gracilis*), pubescent and slender wheat grass (*Agropyron trichophorum*), and sheep fescue (*Festuca ovina*) grasses were used for stabilization, along with shrub material such as woods rose (*Rosa woodsii*), mountain mahogany (*Cercocarpus ledifolius*), oakbrush sumac (*Rhus trilobata*), silver buffaloberry (*Shepherdia argente*), golden current (*Ribes aureum*), and sage brush (*Artemisia tridentata*).

Costs: $48 per linear foot as compared to projected costs of $90 per linear foot for rip-rap.

Fall News Notes

GCSAA Commits $25,000 to Turfgrass Research

Randy Nichols (left), President of the Golf Course Superintendents Association of America, presents a $25,000 check earmarked for Turfgrass Research to Stuart Bloch, President of the USGA. The donation reaffirms GCSAA's commitment to the research program and its partnership with the USGA, dedicated to improving the surfaces on which the game is played and ensuring the prudent use of our natural resources and protection of the environment. The presentation was made at the GCSAA reception held in conjunction with the 1993 U.S. Open in Springfield, New Jersey, in June.

New Book on Landscape Naturalization Is Now Available

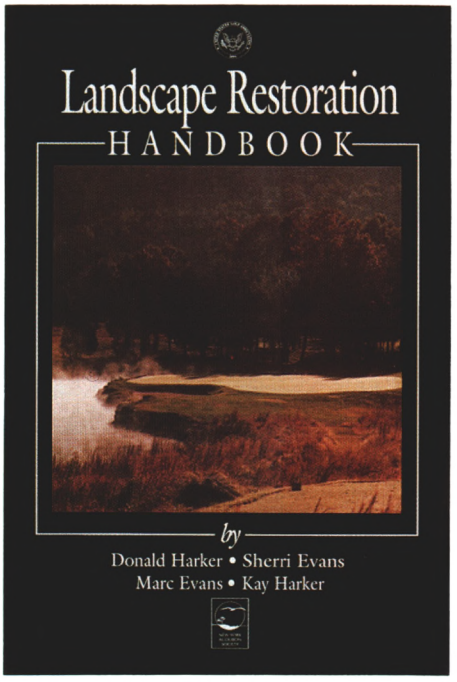
The USGA is pleased to announce the availability of the *Landscape Restoration Handbook*, a comprehensive guide that demonstrates how to use naturalization as an alternative to more intensive management of the landscape. This 688-page book discusses how to obtain benefits from natural landscaping or ecological restoration projects on golf courses and other large properties. It is an essential guide for water quality improvement, erosion reduction, lower maintenance costs, chemical reduction, ecosystem and ecological community protection, and plant and animal species diversity.

The *Landscape Restoration Handbook* provides a broad-based program for education, regional planning, and increased biological diversity. The book also provides an extensive list of scientific and common plant names associated with ecological communities thoughout the United States. Plant characteristics covered in each listing include plant type, environmental tolerance, aesthetic codes, wildlife value, color, bloom time, and landscape uses.

The book is organized by region so that golf course architects, superintendents, horticulturists, urban planners, and consultants can find the specific information they need to plan and implement a natural landscaping or ecological restoration program. A full-color, 22" × 35" ecoregion map is included, in addition to a list of nurseries that propagate and sell native plants throughout the United States.

Landscape Restoration Handbook is available for $82.25 (includes shipping and handling within the United States) from the USGA Order Department (1-800-336-4446) or Lewis Publishers, 2000 Corporate Blvd. NW, Boca Raton, FL 33431 (1-800-272-7737).

The book is a publication of the United States Golf Association in cooperation with the Audubon Society of New York State.



Binders Keepers

Tired of trying to find that issue of the *Green Section Record* located somewhere in the stacks of back issues strewn about your office? Do you want to keep your past issues close at hand for easy reference? The solution has arrived! Custom-made binders have been designed especially for the *Green Section Record*; each will hold two years' worth of issues. The binders are a handsome forest green and have the USGA logo and *Green Section Record* emblazoned on the spine and cover. The binders cost $9.95 each (plus $3.45 shipping and handling) and can be purchased by calling the USGA Order Department at 1-800-336-4446.

USGA Research Summaries Available

Research summaries for the 1983-1992 Turfgrass Research Program and the 1992 Environmental Research Program are now available at no cost from the USGA.

The 1983-1992 Turfgrass Research Summary provides a summary of results of the

past 10 years of turfgrass research. During this decade, more than $5 million was spent to fund more than 40 different projects to develop new grasses for golf that use less water and help lower maintenance costs, and to encourage a new generation of young scientists to become leaders in turfgrass research. The accomplishments of these projects are described throughout the report, and a list of theses and other publications that have been generated by this research has been compiled. The graduate and post-doctoral students who benefitted from grants provided through the USGA/GCSAA Turfgrass Research Program and the individuals, associations, and clubs who have contributed to the program also have been listed.

The 1992 Environmental Research Summary presents the second-year data from the 21 projects conducted in conjunction with the USGA's three-year, $3.2 million Environmental Research Program. These studies are investigating the effects of golf course activities on the environment. A primary focus is to determine what happens to pesticides and fertilizers when applied to golf course turf. Other aspects of the program involve the development of alternative (non-chemical) methods of pest control and the investigation of the effects of golf courses on people, wildlife, and other organisms.

The research summaries are available free of charge by contacting Mary Jane Kymer at the USGA Green Section (908-234-2300) or by writing to the USGA Green Section, P.O. Box 708, Far Hills, NJ 07931.

ALL THINGS CONSIDERED

Treat the Symptom . . . or Correct the Cause?

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

FIFTEEN YEARS AGO, I learned a valuable lesson from a man with almost no education who worked as a laborer on the course where I was superintendent. I was having a terrible time with skunks that seemed determined to excavate the landing areas of many of our fairways. What really aggravated me was their uncanny ability to understand which fairways showed up best through the windows of the dining room and wreak the most havoc where all could see.

To my wife's chagrin, I spent many nights cruising the course on a four-wheeler armed with shotgun and Q-beam. Everyone who drove into the club the next morning with windows open could tell if the previous night's hunt had been a success.

Papa had worked on this course for almost 30 years when I showed up as the new superintendent. I believe he was beyond surprise at the ideas and theories of new superintendents. Each morning following my "polecat round-trip," he would dutifully collect the carcasses and bury them without complaint. Had it not been for Papa's respect for my wife, he probably would never have said anything. But finally one morning Papa asked, "Mr. Jim, why don't you kill the bugs (grubs in our case) instead of worrying about the skunks?" Papa just delivered a good lesson in integrated pest management and humility all in one brief sentence.

As the years passed, I guess the lesson faded. Like a lot of superintendents, I struggled to keep up with the rapidly evolving technological side of the profession. I tended to be the first to try every new chemical, and as was the case with the skunks, attacked weeds, insects, and disease organisms with a vengeance.

Last year I was taught the old lesson again, this time by a group of men on the other side of the world. For over two weeks I traveled with the agronomists of the New Zealand Turf Culture Institute. I watched these men deal with many of the same problems we encounter on our Turf Advisory Service visits here at home. (It seems that Green Committees are a global problem.) However, when it came to dealing with damage caused by non-human pests, I realized their approach was fundamentally different from my own. After diagnosis of the problem, their next step was to identify the conditions that caused the problem to occur rather than simply "writing a prescription" for the correct chemical to cure the symptoms.

Unfortunately, I visit many superintendents who would be more inclined to shoot the skunks rather than remove their food source. When faced with weak greens or unthrifty turf, they tend to look first for chemical fixes. For proof of this, just look at the barrage of new products on the market claiming to fix every soil problem and prevent every disease, all through the miracle of technology (while still being "natural" and "organic," of course). Don't get me wrong. I am not saying the use of chemicals to maintain good turf is improper. What I am saying is that it should not always be our first option and never should be the only option we consider.

All of us must constantly remind ourselves of the basic and simple needs of turf before we begin our search for complicated, high-tech solutions. When faced with a turf problem, first ask yourself these questions:

- Is there enough light?
- Is there enough good soil?
- Is there enough water?
- Are there enough nutrients?
- Is there enough air movement?
- Is there too much traffic?

I know. These are the tired old axioms of plant management we first learned in Horticulture 101. They are neither complicated nor highly technical. We won't impress anyone with our agronomic expertise when we point out that one or many of these factors are lacking. Worst, people tend not to like the solutions to these problems. Have you tried to convince the average golfer to allow the removal of a few trees lately? Or how about keeping the carts on the paths?

While it's true that you might be able to make the weakened turf temporarily stronger by applying the right pesticide, you have only treated the symptom, not corrected the cause. While correcting the cause is almost always harder and admittedly sometimes impossible, we all need to at least make the effort. We owe it to our employers, our industry, and ourselves.

TURF TWISTERS

IMPROPER TIMING OF

Question: Everyone on our Green Committee is well aware of the importance of proper timing of certain maintenance activities. Our intentions and tentative plans are always good, but it seems that year after year golfing events force aerification work further into the fall than is ideal. I doubt we are the only club with this type of problem. How would you suggest we approach this situation? (Maryland)

Answer: The fact that your Green Committee is aware of the importance of maintenance work timing is very commendable. We encourage you to communicate this actively to the Golf Committee, which has to schedule golf events in the first place, and to the pro shop. Get together with the Golf Committee and pro shop staff during the winter months and place your maintenance activities on the club's calendar as the highest priority. With maintenance work on the calendar, golfing events can be added where appropriate. As an added measure, schedule a rain date for your maintenance work, just like any golfing event. This approach will help prevent golfing events from dictating your maintenance work.

CRITICAL MAINTENANCE

Question: I just can't believe bentgrass can utilize all the nitrogen I have had to apply to our new greens during the grow-in period. What's up? (Minnesota)

Answer: Probably your water use. It is very easy to overwater new, high-sand greens, resulting in soluble nutrients being leached from the root zone. Try to determine just how little water is needed to keep the surface moist. Several light sprinklings during daylight hours usually will suffice once the entire profile is moistened. As the root system develops, the frequency can be reduced. You should also be aware that high pH levels may limit the availability of nitrogen from some slow-release sources, and low microbiological activity in the root zone can slow the N release from other sources.

MAKES FOR DIFFICULT PLAY

Question: We have an old links-style golf course with many mounds or "chocolate drops" that are left unmaintained in the roughs. Over the years many have become overgrown with different varieties of weeds and unwanted vegetation, making for very difficult play. Any suggestions on how to return these areas to their original state without losing too much of the old fescue mix that we'd like to keep? (New York)

Answer: Controlled burning during winter dormancy historically has been used for eliminating unwanted vegetation and keeping naturalized rough areas playable. However, burning can damage more delicate fine fescues, and permits may be impossible to obtain. Several broadleaf herbicides are available and can be applied in mid-spring or early fall to safely control weeds on the mounds. Invading shrubs may have to be removed by hand or treated with a nonselective herbicide. Mowing the naturalized areas in late fall also will help control weeds and improve playability if burning is impossible.