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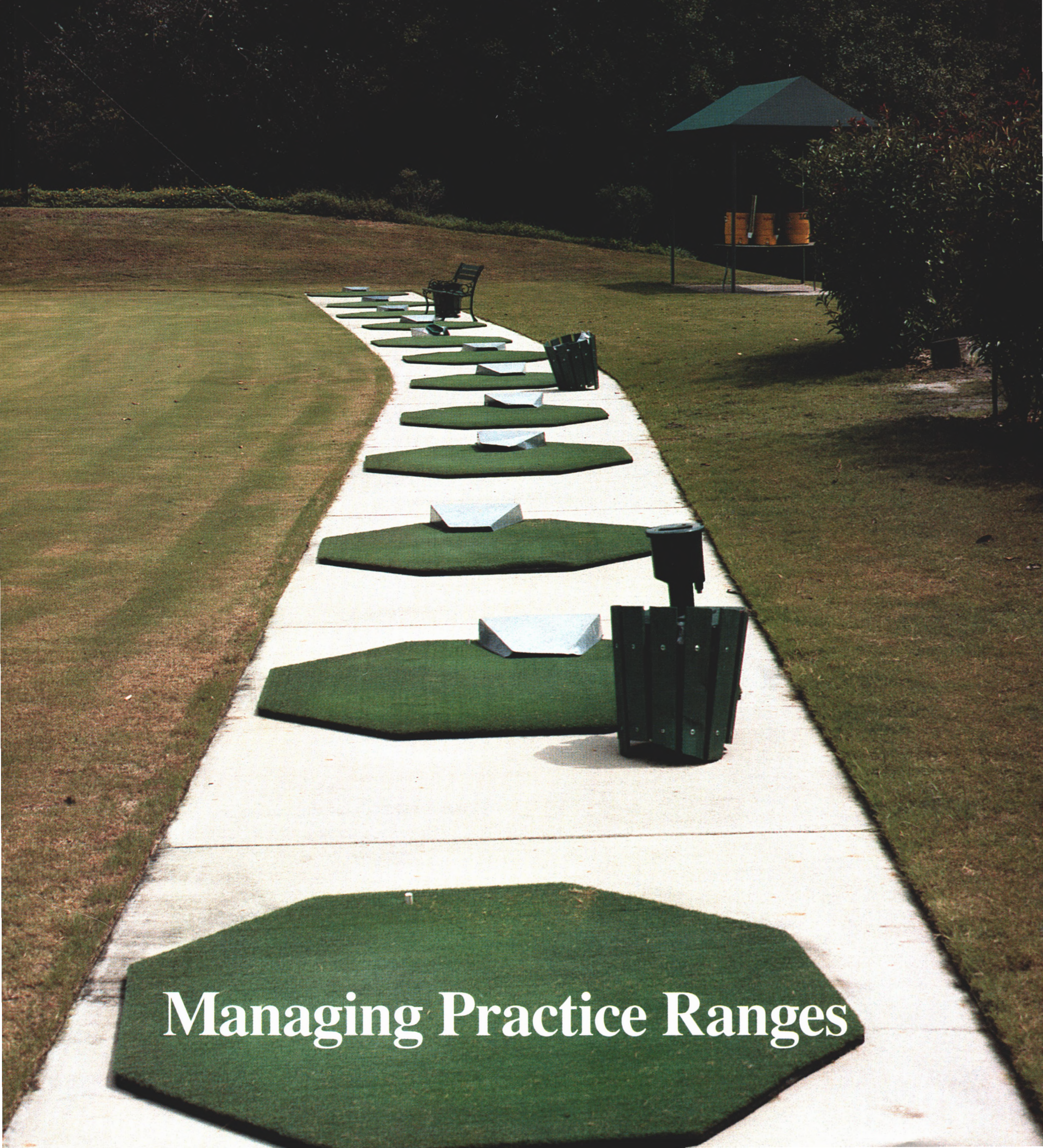

Managing Practice Ranges

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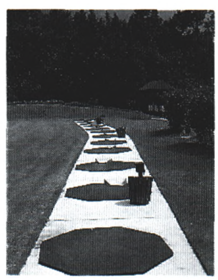

Cover Photo:
Artificial tees are a practical solution to the challenge of managing practice ranges.

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A practice park at World Wood Golf Club, Brooksville, Florida, offers the ultimate in practice facilities. In addition to a 22-acre practice park with eight separate teeing areas, the facility includes a two-acre practice putting green, three practice holes, an irons range, and a nine-hole short course.

Turf Management in a Battle Zone: Practice Ranges

by JOHN H. FOY
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KNOWN BEST for designing a number of this country's great golf courses, Donald Ross also is credited with the invention of the lesson and practice tee. Prior to this innovation, all practice except putting was done on the course, and lessons were playing lessons. According to the late Herb Graffis, Donald Ross first incorporated a lesson and practice tee in one of his course designs in 1914. It was also the opinion of Mr. Graffis that this innovation played an important role in the worldwide growth of the game.

The popularity of golf has certainly grown, and according to the National Golf Foundation, there were 24.5 million golfers in the United States in 1993. Last year, two million people played the game for the first time, and this has been a steady trend for the past six years. This constant growth in numbers leads to more and more golfers who are warming up before their rounds. The condition of the practice areas, therefore, can have a big impact on the perception of

the overall quality of a golf facility. For golfers who are actively pursuing improvement of their game and want a "total" practice experience, or for individuals who do not have time for a round of golf but want to come to the course and hit balls for a while, the condition of the practice facility is even more important. Quite simply, practice facilities can be an asset or a detraction to an operation.

Particularly with daily fee and municipal operations, a practice facility can be another revenue source. At North Palm Beach Country Club, which is operated by the Village of North Palm Beach, Florida, a net income of approximately $55,000 was realized in 1993. Although this is a year-round operation, cutting this figure in half for areas of the country with shorter operating seasons still leaves a tidy sum.

Even though there are examples of well-designed and maintained practice facilities across the country, they tend to be the exception and not the rule. During the vast majority of Turf Advisory Service visits conducted here in Florida, a stop is made at the driving range, and options are discussed for improving the level of quality maintained. In discussing the subject of practice facilities with other USGA staff agronomists, this scene is repeated regularly across the country. Problems associated with maintaining a good quality practice facility are not new. A review of the information available on this subject from the Turfgrass Information File (TGIF) at Michigan State University reveals that inadequate and poorly maintained practice facilities have been an area of frustration both for course superintendents and golfers over the years.

Following is a discussion of practice facility design considerations. Then, basic setup and maintenance practices are reviewed, along with a few options for dealing with problem situations.

Facility Design Considerations

To design a good practice facility, take best advantage of the site. The following recommendations reflect the ideal. One or more site conditions may dictate that you settle for less than the ideal.

Regardless of topography, property configuration, soil conditions, and existing vegetation, the ideal is a north-south orientation and into the prevailing wind. East-west/west-east tees are least desirable, as users will have a difficult time seeing the ball in the early morning or late afternoon. Hitting with the wind undermines the perception of how far one can really hit the ball and does not allow the serious player to practice the trickier "into the wind" shots. For the same reason, uphill practice is preferable for sites with modest to severe elevation changes. On such sites, though, it may be possible to arrange for the player to hit short to mid-irons downhill into a valley, or to targets at the same elevation as the tee, and uphill for long irons and woods.

Property configuration will dictate more than any other feature the size of both tee and target areas. The ultimate width of the tee surface will be determined by the breadth of the property where the tee is to be placed,

(Above) More than 300 golfers in one place for the U.S. Amateur Championship could be a superintendent's nightmare. The TPC at Sawgrass handled the challenge in 1994 with an 80,000-square-foot practice area. This ample size provided adequate recovery time for the Tifway 419 bermudagrass.

(Right and below) All-weather or artificial turf practice tees are becoming more commonplace on golf courses. A more realistic feel and other improvements in these materials have helped increase their acceptance.

less any width needed for cut or fill slopes. Anticipate 8 to 10 feet of width per station, e.g., three foursomes at 10 feet each suggests a tee surface 120 feet wide. A depth of 5 to 10 feet per daily hitting line change needs to be available, with a minimum of a 4- to 6-week rotation. With a 5- to 10-foot-deep hitting line and a 28-day rotation, 140 to 280 feet of depth on the tee surface is needed. If the tee is shaped with a slight curve (half an ellipse), a few additional spaces may be obtained. This crescent shape encourages end-users to align themselves towards the targets and, subsequently, fewer balls will be hit outside the confines of the facility.

Some sites are of sufficient length to allow tees at each end of the range. Three hundred yards from the front of the primary tee to that of the secondary tee is currently recommended. The hitting line on the tees should be adjusted at the same time so that as one line is forward, the other is back to maximize the distance between the two. Mention should be made that longer ranges are necessary where the player is hitting with continuous strong prevailing winds or at higher elevations, as the less-dense air allows golf balls to travel farther.

Targets have evolved to greens, some with bunkers. Positioning these target greens will depend, to some extent, on the depth of the tee(s), as the distance may vary as much as 80 yards. However, locating five targets so that short, mid, and long irons and lofted and straight-faced woods each can be used by the skilled and less-skilled players from varied hitting lines would be appropriate. Vertical plaques for easy viewing can be placed on the tees according to laser-measured distances.

Critical to tee design is its construction. Proper construction requires adequate drainage — surface and sub-surface. Loose, sandy soils on flat ground can be "pushed up," leveled, and seeded or sprigged. Tight, clayey soils may require sub-surface drainage (herringbone style similar to that below putting greens). An easier method is to shape a "V"-type subgrade at 1½-2% slope with one drainpipe set in washed pea gravel in the bottom of the "V." The outfall can be into an unused area or into a large drainpipe. A 1% to 2% fall in the "V" should be sufficient for water to move through the pipe. Two to four inches of pea gravel should then be installed over the subgrade with sufficient (6 to 8 inches) high-sand root zone mix over that to allow aerification. A steeper subgrade will obviate the use of pea gravel and only slightly increase the amount of mix required. A flat surface then can be graded. On soils and terrain not requiring sub-surface drainage, a pitch of 1% from front right to back left is preferred. Tees benched into a hillside may be canted from back to front at 1% to prevent view obstruction, especially if an exceptionally deep tee is being built. Regardless of the direction of pitch, a benched-in tee favors use of drain tile and gravel at the back and/or side of the tee(s) to prevent excess water crossing the tee.

Ready access to the tee, especially if wide and deep, is essential. Golf cart access and staging behind the tee and an easily negotiated slope from cart path to tee surface are desirable. A more controlled access will be seen at resort and daily-fee operations.

Despite the varied dimensions of a practice facility (150 to 600 feet wide and 900 to 1500 feet long), the target on a typical, rectangular range should be center and left of center, particularly for the long-yardage targets, to accommodate the slice tendency of the average player. The greens should be raised slightly and shaped so as to be viewed and to accept shots from tees at each end. The secondary tee is often used for clinics, teaching, and by those who practice seriously.

Target greens at some public and resort facilities are raised enough to serve as a shield for set-in, ground-level lighting, which can be used instead of, or as a supplement to, pole lighting. Obviously, a tee at each end is not a good idea in this situation. Practice putting greens, chipping greens, and bunkers are frequently being installed as part of new or upgraded facilities.

Practice putting greens planted with the same type grass and built and contoured in the same manner as their golf course counterparts, should be a minimum of 10,000 square feet and linear, if possible, to accommodate more people without "cross-over" putting. Prime positioning is behind the practice tee or near the first tee.

Practice bunkers and chipping greens preferably are located left of the range tee. A linear chipping green can be positioned so that those hitting chip or bunker shots are

Controlling the amount of available tee area and regularly moving the hitting line are a must, no matter what the level of usage.

not aimed towards others on the tee. One or two bunkers can be built to simulate the kinds of shots expected on the course.

The practice fairway bunker may be an extension of the greenside bunker, but is preferably its own entity. It should be shallow enough to replicate what might be found on the course and wide enough to handle two or three players. Construction and sand should be the same as is found on the course.

Although the preferred perimeter screen is some kind of tall, dense evergreen tree (varies by climate), fence or netting may be required, depending on the topography, acreage, and adjacent land use. It is possible to effectively camouflage nets or fences with landscape plantings. Screening brings us back to the initial design consideration — solar orientation. Too much shade on the tee (especially in the morning) will mean a consistently inferior surface. Thus, to screen the practice tee, hedges and trees should be planted behind the cart path, not between tee and cart path.

Basic Setup and Maintenance

Regardless of the type of turf on the tee, controlling usage is vital in winning the battle of maintaining a practice facility in good condition. In addition to clearly defining the hitting area, the hitting line must be regularly moved so that recovery from damage can occur. At some courses, the golf professional staff handles setup of the practice tee, but it would be logical to include this with the daily course setup process. After changing the tee marker and hole locations on the course, the individuals assigned to this task can take care of the range tee before moving on to their next job for the day.

A common and successful practice tee setup is defining the hitting line with a rope securely anchored to the ground. A 7- to 10-foot-deep hitting line is suggested, and the individual hitting stations should be delineated by 2- × 4-inch boards, bag stands, or other fixed markers spaced 8 to 10 feet apart. The hitting line should be progressively moved, starting at the front of the practice tee and working back or vice versa. When heavy usage and damage are not experienced, a good option for increasing the usable area is simply to shift the individual hitting stations over to the left or right before rotating the hitting line back. Not making a complete 7- to 10-foot hitting line change can help in increasing the rotation and recovery time available. It should be noted that the use of two parallel ropes for defining the hitting line is no longer being recommended because of injury and liability problems that have occurred from golfers catching the forward rope with their clubs.

Although the innovation of the lesson and practice tee has doubtlessly contributed to the growth of the game, the advent of annual range use programs has resulted in more problems with maintaining a good quality turf cover. With a one-time annual fee, the number of practice balls hit by an individual or family goes up dramatically. Also, a common amenity at many private clubs in Florida is putting out large baskets of practice balls on the tee for the members' use. As long as the practice balls are readily available, there are some golfers who will continue to hit them. A review of the tee surface may suggest that controlled use be a part of an annual range program. This is particularly true when tee size is limited. Experience suggests that simply going to the use of bags or small buckets of balls and providing only a couple of those at a time can significantly reduce the amount of time most of the golfers spend on the practice tee. This, in turn, limits divot damage.

Once the hitting line has been moved, an effort must be made to promote rapid recovery of damaged areas. During periods of peak play, the hitting line needs to be moved every day or every second or third day. With bermudagrass practice tees, simply filling in the divots with topdressing material and making a broadcast application of a complete fertilizer is usually adequate during the summer growing season. Supplying the equivalent of 0.5 to 1.0 pounds of actual nitrogen per 1,000 square feet every 7 to 14 days is suggested. Furthermore, the use of sand plus peat or some other organic material, such as processed sewage sludge, is preferable to the use of a straight sand topdressing on most practice tees.

In discussing practice facilities with other Green Section agronomists, it was noted

To maintain a smooth surface and dense turf cover on practice tees, topdressing of divot damage, adequate fertilization, and reseeding must be routinely practiced.

that although there are a few courses that have bentgrass tees, the dominant turf cover used in cool-season turf areas is perennial ryegrass. To produce quality bentgrass practice tees, the combination of very low usage and an extremely large area must exist. The fast establishment and durability of the ryegrasses makes this species the best suited turf for practice tees throughout the northern portions of the country. In a few areas, combinations of perennial ryegrass and some of the newer Kentucky bluegrasses are being used. The objective here is to take advantage of the spreading growth habit of the bluegrasses. It has also been a standard practice across the southern areas of the country to overseed bermudagrass-based tees with perennial ryes for the winter months.

However, due to the bunch-type growth habit of the ryegrasses, reseeding of damaged areas must be routinely practiced to reestablish the turf. There are numerous methods of reseeding, but a common denominator with successful programs is performing this work immediately after moving the hitting line. Some use a combination of pre-germinated seed and topdressing, whereas others apply the materials separately to fill in the damaged areas. Depending on the severity of damage, broadcast or spot treatment applications can be used, and then the materials can be dragged in to produce a smooth surface. The application of a starter-type fertilizer also is suggested. Furthermore, supplying 1 pound of actual nitrogen per 1,000 square feet per month is recommended as a basic management practice for perennial ryegrass practice tees. Ideally, a period of 4 to 5 weeks needs to be allowed for the turf to reestablish before the area is put back into use.

With respect to the management of practice putting/chipping greens and bunkers, these areas receive more concentrated use than the corresponding areas on the course. Logically, then, maintenance inputs must be higher. However, since conditions are variable across the country, standardized recommendations are not possible. An important situation not to overlook is the additional buildup of sand on turf areas adjacent to practice bunkers. For these locations, annual or even bi-annual removal of sand accumulations may be required to keep the turf in acceptable condition. The practice range fairway should be managed just as the rest of the fairways on the course, though it rarely happens this way.

Options for Problem Situations

Boca West Country Club in Boca Raton, Florida, has been faced with an ongoing battle in trying to maintain the level of practice tee quality desired. This is especially true during the winter season when 70% to 80% of their play occurs. Boca West is a very large development complex with four courses for its 2,800 golfing members to use, and its practice range is in almost constant use. Last year it was calculated that well over 3 million golf balls were hit!

At Boca West, there is only 72,000 square feet of teeing area. Even with adherence to a continuous grow-in fertilization program and daily reseeding during the winter months, Billy Wright, Director of Grounds, and his staff are in a no-win situation. To aid in this battle, a permanent hitting line with an artificial turf cover was installed a couple of years ago along the back of the south teeing area. Different surface materials have been tried, and it seems that the best setup is individual hitting mats that can be replaced easily when they wear out. The use of artificial turf mats has definitely helped at Boca West by providing more time for the turf to recover and some reduction in divot damage.

Although Boca West is an extreme case, many other clubs and courses would benefit from the installation of a permanent hitting line on their practice tees. Over the years, improvements in both appearance and play characteristics have been made in artificial turf materials. Calling them *all-weather* practice tees increases the acceptance of artificial turf tees.

There are times when the members should be required to use these tees, but a policy stating that all outside groups and outings are required to use the all-weather teeing areas makes them more palatable at private clubs. All-weather tees typically are placed along the back of the practice tee, but locating them in the front should be considered. With this arrangement, the maintenance staff can work on the rest of the practice tee while the facility is kept open.

Another common problem on practice tees is achieving good turf reestablishment. To insure good initial seed germination and establishment of reseeded areas, frequent supplemental irrigation applications are required for two to three weeks. Obviously, this can be a problem when the practice tee is in use. A good solution is the installation of rows of small pop-up mist or residential type irrigation heads across the practice tee.

Finally, to improve the depth perception and aesthetic character of target greens, bunkering is a desirable design practice. Yet, traditional sand bunkers require a lot of maintenance, and the practice balls must be picked up by hand from in and around these areas. A solution that has worked quite well in Florida is to replace the sand with a white crushed rock material. When the rock is firmly packed into place, the ball pickers can drive right over the bunker and the only other maintenance required is periodic edging and spot weed control.

We fully realize that at some courses, space and/or budget limitations restrict the type and quality of practice facilities that can be provided. Yet continuing to ignore the problem will not make it go away. Only by giving the practice facility a higher priority will it be possible to win the battle and meet the expectations of the golfers.

When limited space is an issue, there are simply not any options available.

SALINITY MANAGEMENT

by **REED YENNY, CGCS**
Mesa Verde C.C., Costa Mesa, California

IT SEEMS to be a universal truth that an ounce of prevention is worth a pound of cure. It is true in medicine, in criminal justice, and it's also true in turfgrass management. In the arid and semi-arid regions of the United States, the successful management of soil salinity conditions requires preventive action. If preventative measures aren't taken and conditions reach a critical point, it could mean starting over from barren soil.

Fundamentally, salinity is the total concentration of soluble salts in either the irrigation water or the soil solution. Salinity is measured as electrical conductivity (EC) in either decisiemens per meter (dS/m) or millimhos per centimeter (mmhos/cm). To approximate EC from total dissolved salts (TDS), the value reported in ppm is divided by 640. Likewise, to roughly convert EC to TDS, the value reported in dS/m or mmhos/cm is multiplied by 640.

Salinity affects turfgrasses by lowering the osmotic pressure in the soil solution, thus limiting water availability to the root system, or by physically destroying the soil's structure. When these two destructive forces are combined, the turf wilts prematurely and gradually declines over a long period of time.

Frequently, salinity buildup in the soil is misdiagnosed as a disease problem. This is especially prevalent on courses with annual bluegrass-bentgrass putting greens, and often prompts the needless application(s) of fungicide(s). However, in defense of turfgrass managers, it is true that turfgrasses are weakened by salinity buildup and therefore are more susceptible to disease infection. The proper cure in this situation is to manage both the salinity and the disease, not just the disease alone.

Salinity buildup is an inevitable process in many parts of the country and occurs as salts in the irrigation source accumulate in the soil. Through evapotranspiration (ET), salinity increases in the soil because only pure water evaporates from the soil and transpires from the leaf surfaces, leaving salts behind. At best, the resulting buildup can be leached below the root zone or into an artificial drainage system by scheduling extra irrigation in proportion to the salinity increase.

The amount of water required to reduce soil salinity to an acceptable level is primarily a function of the salinity of the irrigation source. As a rule, the higher the salt content of the irrigation source, the higher the requirement for extra irrigation to prevent excessive salinity buildup. Other factors that must be considered to leach salts from the soil include infiltration rate, surface compaction, irrigation scheduling, and the use of the facility.

When salinity is a problem, infiltration must be monitored and steps taken to improve the water infiltration rate. If this problem is not corrected, adequate irrigation cannot be scheduled to move salts below the root zone. Compacted turf areas may need to be aerified before attempting to leach salts to help reduce runoff and allow more water to enter the soil.

Irrigation scheduling should always be planned to minimize excess runoff. Typically, multiple 30-minute cycles are more effective than a single irrigation cycle of one to two hours. Low emission, portable sprinklers also can be very effective for small areas or putting greens with surrounding bunkers or steep grades.

The use of the facility immediately after leaching is often ignored as a potential problem, but is nonetheless an important consideration. Depending on how the greens are built, putting greens can require several hours to adequately dry before they are suitable for play. If the course is closed on Mondays, then Sunday nights would be best for scheduling leaching irrigation cycles.

When high temperatures coincide with salinity buildup, managing the situation is even more difficult. On one hand, the irrigation system may not be able to apply the needed volume of water within a given time period to maintain healthy turf and leach the soil. On the other hand, the soil may be so impervious that it will not accept the needed volume of water without becoming soft and unplayable. Extra care needs to be taken in these situations.

Table 1
Relative Tolerance of Turfgrasses to Soil Salinity

Sensitive < 3 dS/m	**Moderately Sensitive** 3-6 dS/m	**Moderately Tolerant** 6-10 dS/m	**Tolerant** > 10 dS/m
Annual bluegrass	Annual ryegrass	Bent. cv. Seaside	Alkaligrass
Colonial bentgrass	Chewings fescue	Perennial ryegrass	Bermudagrass
Kentucky bluegrass	Creeping bentgrass	Tall fescue	Seashore paspalum
Rough bluegrass	Hard fescue	Buffalograss	St. Augustinegrass
Centipedegrass	Bahiagrass	Zoysiagrass	

Harivandi, M. A., Butler, J. D., and Wu, L. 1992. Salinity and turfgrass culture. Turfgrass Series No. 32. American Society of Agronomy, Madison, WI.

Sometimes salinity buildup is misdiagnosed as a disease infection, setting in motion the needless application(s) of fungicide(s). To help tell these two common problems apart, look for healthy turf growing in recent aerifier holes. This sign indicates salinity may be the culprit because salts are being leached where water penetrates through the green. Note, too, that some golfers never forget to repair their ball marks, no matter how bad the circumstances may be!

Developing a Salinity Management Program

Obtaining accurate soil and water analyses are the first steps in developing a salinity management program. All water supplies should be tested annually. Water analysis should include measurements of EC and sodium, calcium, magnesium, and bicarbonate concentrations.

Soil analysis for salinity should be done a minimum of twice per year. The first analysis should be made at the end of a rainy season to establish a baseline measurement and to detect the effect of annual rainfall on salinity buildup. A second analysis should be made at the end of a dry growing season to detect the total salinity buildup, and to find out how effectively salinity was controlled by the management program. Soil analysis should include measurements for EC, pH, and the concentrations of sodium, calcium, magnesium, potassium, and hydrogen. The sodium adsorption ratio (SAR) also should be calculated by using the sodium, calcium, and magnesium concentrations.

Besides routine water and soil analysis, crude field measurements of electrical conductivity can be used during the dry growing season to judge the immediate results of a weekly or biweekly leaching program. These measurements can be easily made by making a saturated soil paste and measuring with a digital electrical conductivity probe, such as the TDStestr 4 (Cole Parmer, P.O. Box 48898, Chicago, IL 60648-0898, Cat. No. 19088-30).

Data from water and soil analyses also are important for calculating the application rate of needed soil amendments. Typically, amendments used to help correct salinity buildup supply calcium to the soil. The most often used form of calcium is gypsum (calcium sulfate). According to on-site circumstances, gypsum can be applied directly to the turf or injected through the irrigation system.

Agricultural gypsum, or the more expensive pelletized form, is surface applied to the turf. These products are most effective when tilled into the soil. Therefore, soil aerification prior to the gypsum application should always be considered, if possible. To inject gypsum through the irrigation system, finely ground or solution-grade gypsum that dissolves quickly in water usually can be purchased locally.

If the soil has a high free-lime content (calcium carbonate) and a high pH reading, elemental sulfur or sulfuric acid can be used to increase the calcium concentration. This increase in calcium occurs by the reaction between the free lime in the soil and the added elemental sulfur or sulfuric acid which produces gypsum in the soil. The slowest reaction occurs when elemental sulfur is used because it first must be converted by soil microorganisms into sulfuric acid before it can react with the free lime.

It also is important to appreciate that different turfgrass species have a varying tolerance to salinity buildup. Generally, cool-season turfgrasses have a lower tolerance to excessive soil salinity than warm-season turfgrasses. If salinity levels cannot be maintained below the critical point for a

Table 2
Electrical Conductivity and Sodium Adsorption Ratio Measurements for a Green Built with a Well-Drained, Sand-Modified Root Zone

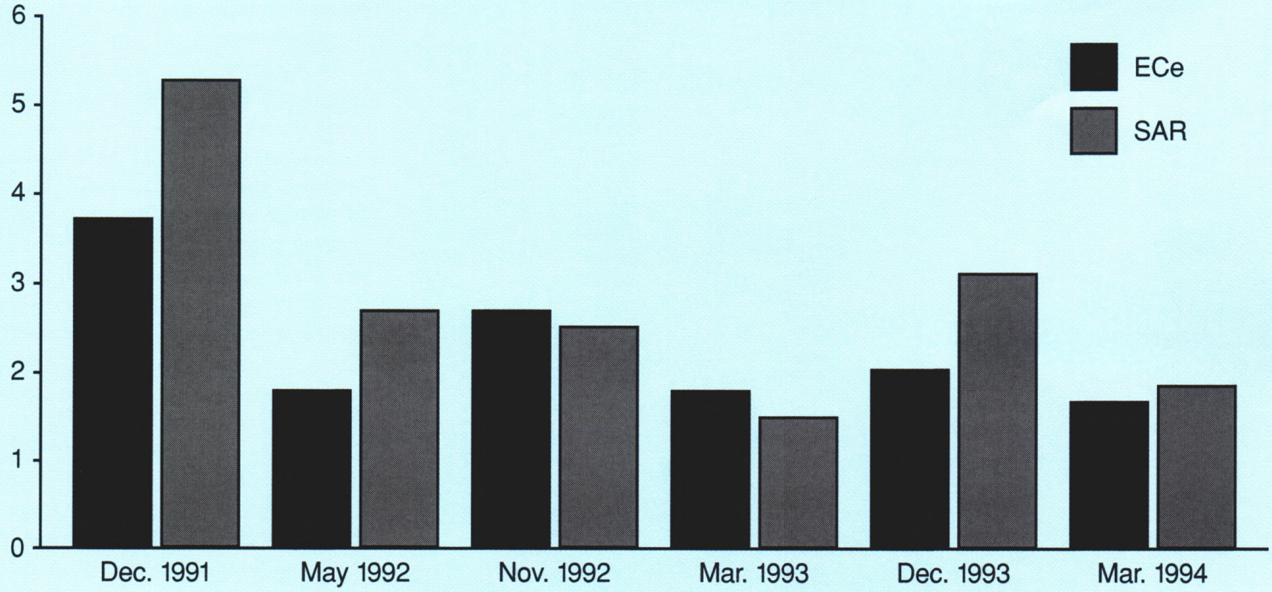
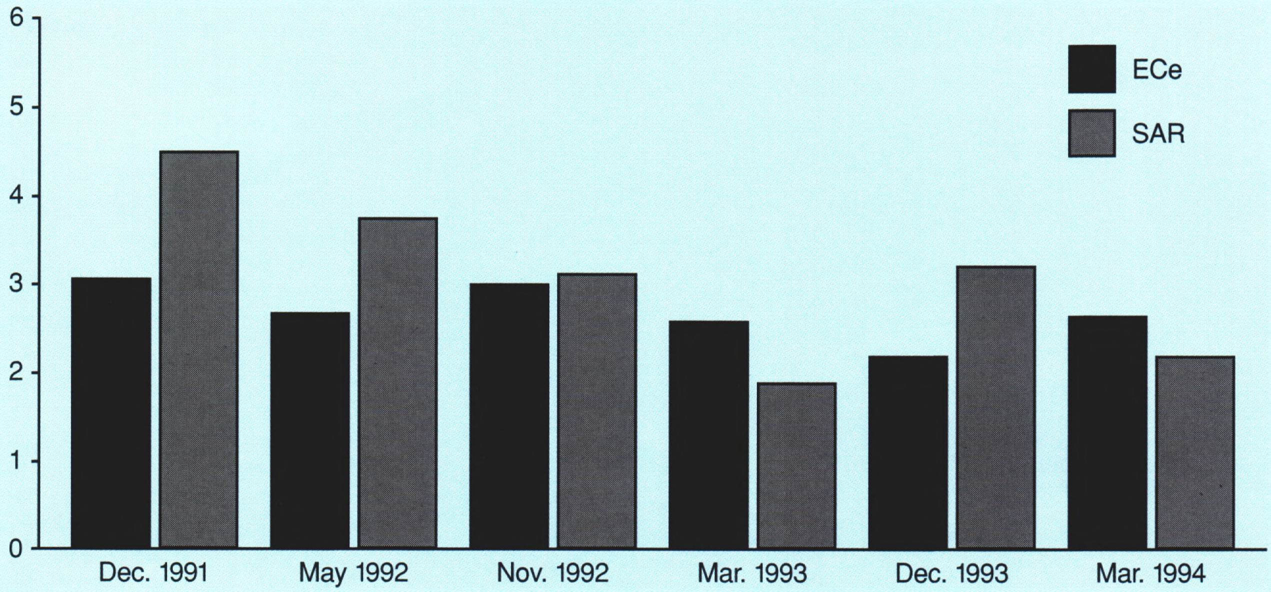


Table 3
Electrical Conductivity and Sodium Adsorption Ratio Measurements for a Green Built with a Poorly Drained Native Soil



particular turfgrass species, then replanting to a more tolerant species should be considered.

Mesa Verde Country Club — A Case Study

Mesa Verde Country Club is a private facility built in the late 1950s. The putting greens had developed a history of occasional turf loss during the late summer because of poor drainage and salinity buildup. The recent drought in California was especially troublesome and caused serious turf loss in the fall of 1990.

An average annual rainfall of less than 7.5 inches for the previous five years produced salinity readings on some greens that exceeded 8 dS/m. For the most part, leaching attempts were ineffective due to the poor drainage that would not allow salts to move past the root zone. Soil and water monitoring were undertaken to develop a strategy for reducing salinity measurements below the upper tolerance range for putting greens dominated by annual bluegrass.

Irrigation source analysis revealed that the well water used on the golf course had

To successfully manage greens with a salty irrigation source, periodic leaching is necessary to prevent salinity buildup. If leaching isn't practiced, the cure for turf loss will inevitably involve starting over from barren soil.

an EC of 0.56 dS/m and an adjusted SAR of 3.39. Normally this is considered good quality water for irrigation; however, research by Dr. James Oster, University of California at Riverside, had shown that low-EC waters are likely to have poor infiltration rates as the SAR increases. As odd as it may seem, both the water infiltration and the efficiency of the leaching program were improved by adding gypsum to the irrigation supply.

Salinity monitoring was initiated in December 1991 after a few light seasonal rains. At this time, the top four inches of the root zone had an EC of 4.7 dS/m and an SAR of 6.8. To maintain annual bluegrass/bentgrass putting greens, salinity needed to be reduced to below 4 dS/m throughout the year and calcium levels needed to be increased to improve soil structure.

A double strategy was developed. First, to improve the infiltration rate of the irrigation source, 700 pounds of gypsum (salt) was dissolved in each acre foot of water (326,000 gallons) used for irrigation. Gypsum was dissolved in the water by a machine that injects a mixture of gypsum and water into the discharge side of the well that feeds the irrigation reservoir. The treated water resting in the reservoir was then pumped through the irrigation system.

The quantity of gypsum applied was based on the amount of calcium needed and the salinity increase required of the irrigation water to improve infiltration. As a point of reference, 235 pounds of 100% gypsum will raise the calcium concentration of the water by 1 meq/liter and the EC by 0.12 dS/m. The use of a digital electrical conductivity meter before and after water treatment verified that the proper amount of gypsum was added.

Second, to improve the quality of the irrigation source, a twice-per-month leaching program was initiated by applying two hours of irrigation in four 30-minute sets. The leaching program was started in the spring of 1991, approximately one month after the last significant rainfall. By starting early in the season, salinity was maintained below the target measurement of 4 dS/m.

Two noteworthy conclusions were made as a result of the salinity management strategy. First of all, salinity buildup in the putting greens built with native soil can be held at a tolerable level. If the leaching program is not started until midsummer, when ET demands are at their highest, it is very difficult to apply enough irrigation water to move the salts below the root zone and still have a firm, playable surface. Secondly, we found that salinity buildup in the putting greens rebuilt with a sand root zone can be reduced faster and with less water compared to those built with native soil.

While most prevalent in the arid and semi-arid regions of the United States, salinity problems can occur anywhere a poor-quality irrigation source is used during drought conditions. To prevent such a set of circumstances from causing the deterioration of top-quality putting greens, the key to success is getting an early start at correcting the problem. Symptoms of salinity damage are not revealed until after turf damage occurs, so electrical conductivity monitoring with regular water and soil analyses is critical. As the old adage says — an ounce of prevention is worth a pound of cure.

RECOVERY FOR WINTER-INJURED GREENS

by **JAMES E. SKORULSKI**
Agronomist, Northeastern Region, USGA Green Section

SEVERE WINTER INJURY due to cold temperatures, ice, or desiccation is likely to occur at most golf courses at one time or another despite all the precautions that are taken. Information is available that can be used to help prevent or reduce potential injury, and with luck those practices will be successful. However, year in and year out, injury will occur somewhere and superintendents will be forced into action to repair the damage and appease the often unsympathetic golfers.

The recovery process that has been preached for years has not changed much, and the basics still hold true. Damaged greens must still be cultivated to create a seedbed, and young seedling turf must be kept moist and well fertilized during the establishment process. Soil temperatures still dictate how quickly seed germination occurs, and the need for patience cannot be overemphasized. However, new equipment and seed technology are now available to help speed the recovery process. Following is a review of the essential recovery strategies and a discussion of how this new technology can improve your results.

A winter recovery program begins first by determining the extent of the damage. This can be analyzed in the field, but an earlier and more accurate assessment can be obtained by bringing plugs indoors from areas where injury is thought to have occurred, where growth then can be forced. Damage is quickly evident as the turf resumes growth. This technique provides a good idea of the extent of the damage.

Good communication is critical once it is determined that damage has occurred. Be open and honest with course officials about the suspected damage and the recovery actions that will have to be taken. This may include the use of temporary greens for the duration of the recovery period. Open communication is essential at this point to avoid surprises later on.

The extent of the damage and the anticipated playing schedule will dictate whether the recovery must be accomplished using seed or sod. The sodding option has become more appealing since the development of washed sod, which reduces soil layering concerns in the soil profile. Having a good quality sod nursery available on the property also makes this option more practical. However, sodding generally is not advisable unless damage is very extensive and recovery is required by an early date. The sodding work itself is difficult, especially when repairing isolated areas of damage on

Ice-related injury in a primary hole location area requires intensive recovery work.

a green. Commercially grown sod likely will produce an inconsistent playing surface due to differences in turf, and this may not be appealing. An alternative is that if one green is severely damaged, the remaining sod on that green can be used to patch damaged areas on other greens. After the green has been stripped of the turf, it then can be regrassed with sod or seed.

The Seeding Option

Achieving recovery with seed begins with developing a seedbed in the damaged areas. Work should be initiated as soon as the soil is workable. There are many ways to do this, including conventional aerification and slice seeding. Some superintendents combine both techniques or double aerify the greens, depending on the extent of the damage. Positive results have been observed with some of the new cultivation attachments developed for conventional aerification equipment. The attachments consist of closely spaced, small-diameter solid or hollow tines that produce a large number of tightly spaced, ¼- to ½-inch-deep holes or dimples that are ideal for seeding. Creeping bentgrass seed can be broadcast at 1½-2 pounds per 1,000 square feet following the cultivation work. A light topdressing application should follow. Avoid excessively high seeding rates, which can result in seedling competition problems.

Seed germination and establishment rates are dictated by soil temperatures. Fortunately, temperatures sometimes can be artificially elevated to hasten germination. Clear plastic covers can elevate soil temperatures most rapidly and help maintain soil moisture. The plastic covers are installed following the overseeding work and are left on the surface until seedling emergence is observed. Geotextile covers also can be installed to hasten germination, and they are effective for moderating soil temperatures following seedling emergence. They work especially well for protecting the young seedling plants from frost, and they help insulate the soils from cold nighttime temperatures. Be sure to monitor the temperatures closely under the covers and be prepared to remove them on sunny, warm days when excessive heat could injure the young seedlings.

Primed seed also can be used to obtain faster germination when soil temperatures are below optimal ranges. Primed seed can be purchased, or priming can be completed in-house. It is a good idea to combine conventional seed with primed seed. The primed seed should germinate more quickly and serve as a nurse crop for the conventional seed. A low-analysis natural organic fertilizer also can be applied during the seeding to provide nutrients and serve as a darkening agent to help raise surface temperatures.

Obtaining good seed germination during a cool spring is a feat in itself, and all the efforts involved with the seeding can be lost very quickly without close attention. Traffic from golfers and equipment can quickly damage young seedling turf. Temporary greens are therefore a must in cases of severe, widespread damage where hole locations are limited. Allowing play on severely damaged greens will delay the recovery process, often resulting in poor quality surfaces for nearly the entire season and sometimes beyond. Wear injury from mowing equipment can be minimized by replacing grooved rollers with solid rollers and by switching to lighter walk-behind machines set at a 3/16" height. The cutting units should be well adjusted and kept very sharp to obtain a clean cut.

Cultural Practices

Fertility management also is important during recovery. Water-soluble nitrogen forms should be utilized initially. They can be applied in either granular form or dissolved and applied at light rates through the spray tank. Avoid using certain slow-release synthetic or natural organic products, as the nitrogen will not be readily available until soil temperatures rise. Ammonium nitrate, ammonium sulfate, or urea-based products work well. The use of the soluble nitrogen forms also helps to avoid excessive nutrient levels in the soil resulting from the sudden release of nitrogen from temperature-dependent fertilizers. Use balanced fertilizer products to assure that both phosphorus and potassium are readily available to the recovering plants. Try to apply at least 1-1½ pounds nitrogen per 1,000 square feet monthly during the recovery to promote aggressive growth. Although promoting rapid early spring growth can make the plants more vulnerable to stress and disease problems, this is a risk that must be taken. Preventative fungicide applications will be required, especially if cool, wet conditions persist.

The young seedling plants also must be kept moist, as they are very prone to desiccation on greens that have been extensively modified with sand. Light, frequent irrigation should be practiced to sustain the shallow-rooted plants. Hand watering the damaged areas is the best means of providing the moisture necessary to damaged areas without overwatering the healthy areas of the green.

Probably the most difficult period of the recovery process occurs two or three weeks into the program. At this point, the young seedling turf is beginning to mature but the areas remain thin. Doubts as to the progress of recovery will be heard from golfers. Sodding often becomes an attractive option at this point despite the fact that good germination has occurred and the young seedling plants are visible. In most cases, the temptation of sodding should be avoided since the young plants will grow quickly, especially as the temperatures warm. Sodding at this point would only eliminate the progress that has been made and probably would not have a significant effect on the final recovery date.

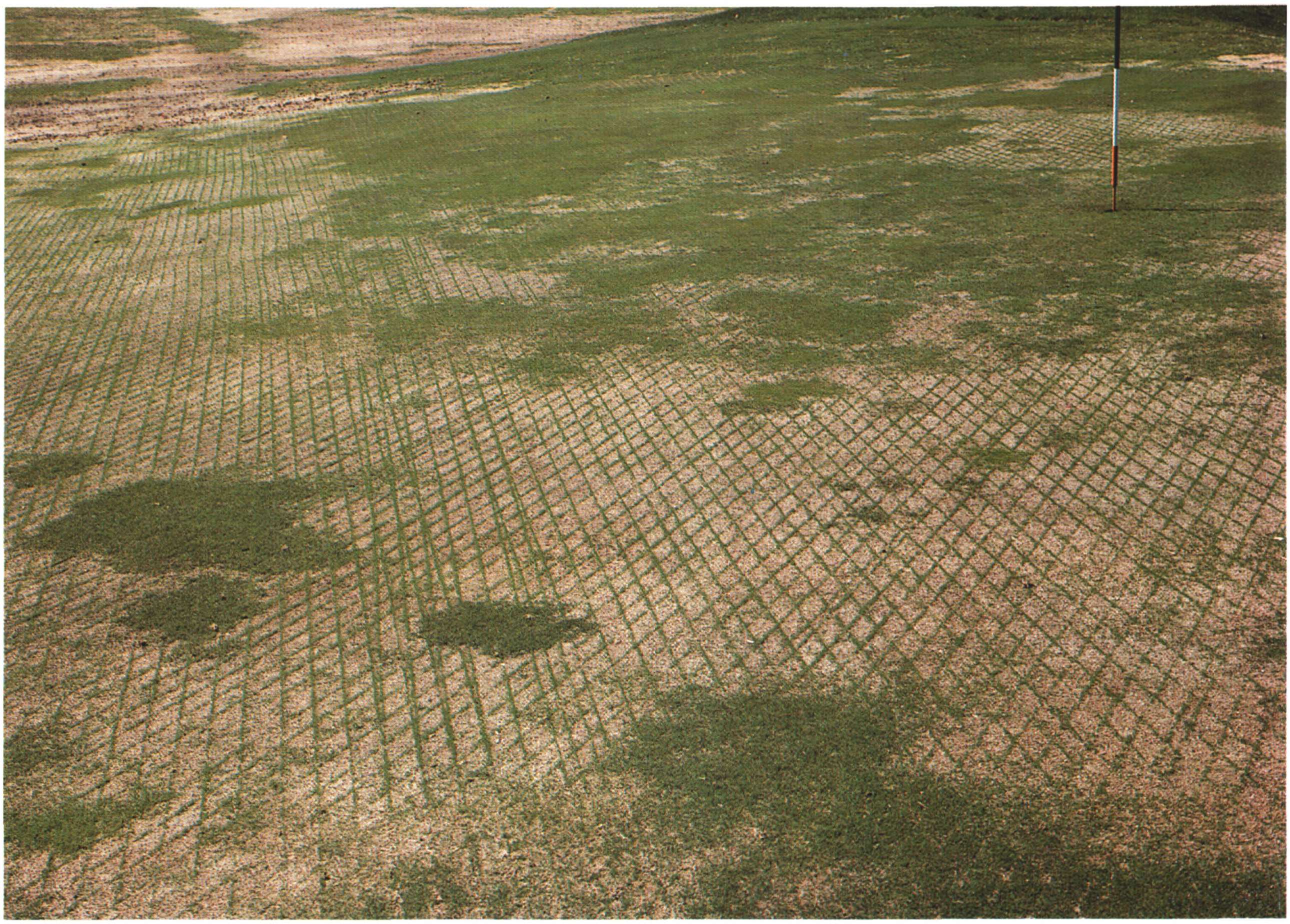
Impatient golfers will demand to have the greens reopened during the latter stages of recovery. Patience is of the utmost importance at this point as the turf may appear to be nearly recovered but often is not. Obtaining turf cover alone does not mean that the surfaces are sound. Opening the greens for everyday play or pursuing aggressive management practices for playability will quickly thin the tender young turf. It might be possible to open the green temporarily for weekend play or special events, but avoid the damaged areas as much as possible. Light topdressing also can be initiated at this point, but care must be taken to avoid abrasion injury. Light vertical mowing or grooming might also be initiated, but do so sparingly to avoid damaging the recovering turf. Recovery should remain the primary objective at this point, with playability taking a back seat. More aggressive manage-

ment practices can be initiated after the turf has fully recovered.

As with any recovery program, patience is critical. This is especially true in spring when growing conditions often are less than favorable. Expect some setbacks during the recovery process as well as some unexpected surprises. Maintaining open lines of communication is critical during the entire process to explain what caused the damage and to set down the ground rules for recovery. Pictures of both the damage and the recovery process are also invaluable. Though they may appear healthy, the damaged areas will undoubtedly enter the summer season in a weakened state. Care must be taken to keep the turf as vigorous as possible and to reduce maintenance intensity for the whole season. The golfers must realize that playing conditions on the damaged greens will be below the standards to which they have become accustomed. Those conditions will be regained, but as with anything good, hard work and patience will be required.

(Left) Although plastic covers have been used in the past, today geotextile covers are used to help elevate and maintain warmer soil temperatures during the recovery period.

(Below) Curtailing traffic on newly seeded areas aids in the recovery process. Keep the golfers off if at all possible!



Density is one characteristic evaluated when comparing bermudagrass varieties for use on a golf course turf.

Introducing New Seed-Propagated F_1 Hybrid (2-Clone Synthetic) Bermudagrass

by A. A. BALTENSPERGER, Ph.D.
Director of Turfgrass Research, FMC,
and Emeritus Professor of Agronomy, NMSU

and J. P. KLINGENBERG, Ph.D.
Research Geneticist, FMC

DURING THE past decade, interest has increased in the development of improved seed-propagated bermudagrass varieties that perform better than COMMON. GUYMON, NuMex SAHARA, SONESTA, CHEYENNE PRIMAVERA, and SUNDEVIL are among the new seeded bermudagrasses that have been commercially accepted (Table 1). GUYMON is more cold tolerant and has an attractive turf color, and NuMex SAHARA is moderately more dense, uniform, and drought tolerant compared to COMMON.

GUYMON was developed at the Oklahoma Agriculture Experiment Station by crossing two selected clones of diverse origin, and from this cross, both first (F_1) and second (F_2) generation seed is produced. NuMex SAHARA was developed at the New Mexico Agriculture Experiment Station by intercrossing eight selected clones followed by repeated intercrossing and reselection, which resulted in a multiclone synthetic variety. With the exception of

ON and COMMON, the 10 named varieties entered in the *National agrass Test—1992** were developed ashion similar to that of NuMex A (Table 1).

recent development of F_1 hybrids or synthetic bermudagrasses will proers with a dense, fine-textured variety n be grown from seed. Experimental 6 and FMC-88 are examples of F_1 s resulting from interpollinating two of *Cynodon dactylon* (L.) Pers. These of many F_1 hybrids that currently are reeding program under evaluation for ality and seed yield.

erent Kind of Hybrid

l-propagated hybrids of the tetraploid dagrass, *C. dactylon* (2n = 4x = 36), een considered for many years. G. W. and co-workers and A. A. Baltenr and co-workers have published le methods for producing such hybrid es. C. M. Taliaferro and co-workers ped the variety GUYMON, where the seed crop was from two clones pro- an *intra*specific F_1 hybrid. The F_1 seed generation) was planted and subsey harvested to produce an F_2 (second ation), which is essentially a synthetic derived from the F_1 hybrid.

FMC-66 and FMC-88 varieties are *a*specific hybrids that are seed propa- That is, both parents are of the same s, *C. dactylon*. They differ from the pecific hybrids, where two different s of *Cynodon* are used as parents in cross (Figure 1). These generally are , producing little or no seed, and are atively propagated. Examples of *inter*fic hybrids are TIFWAY, TIFGREEN, RON, and SANTA ANA.

MC-66 and FMC-88 were developed in by Farmers Marketing Corp. (FMC) at ew Mexico State University (NMSU) ndecker Plant Science Research Center Las Cruces, New Mexico. These F_1 specific hybrids were derived from s of progeny plants developed by cononal plant breeding and selection using estic and foreign plant material. Only ed will be produced and marketed. Seed harvested from these hybrids and other ar crosses in November of 1991 and ediately evaluated in the greenhouse. e hybrids were strikingly more dense finer textured in greenhouse and sub-

opy of the Progress Report 1993 for this test be obtained by writing to: Kevin Morris, ional Program Coordinator, National Turfss Evaluation Program, Beltsville Agriural Research Center – West, Building 002, om 013, Beltsville, MD 20705.

Figure 1

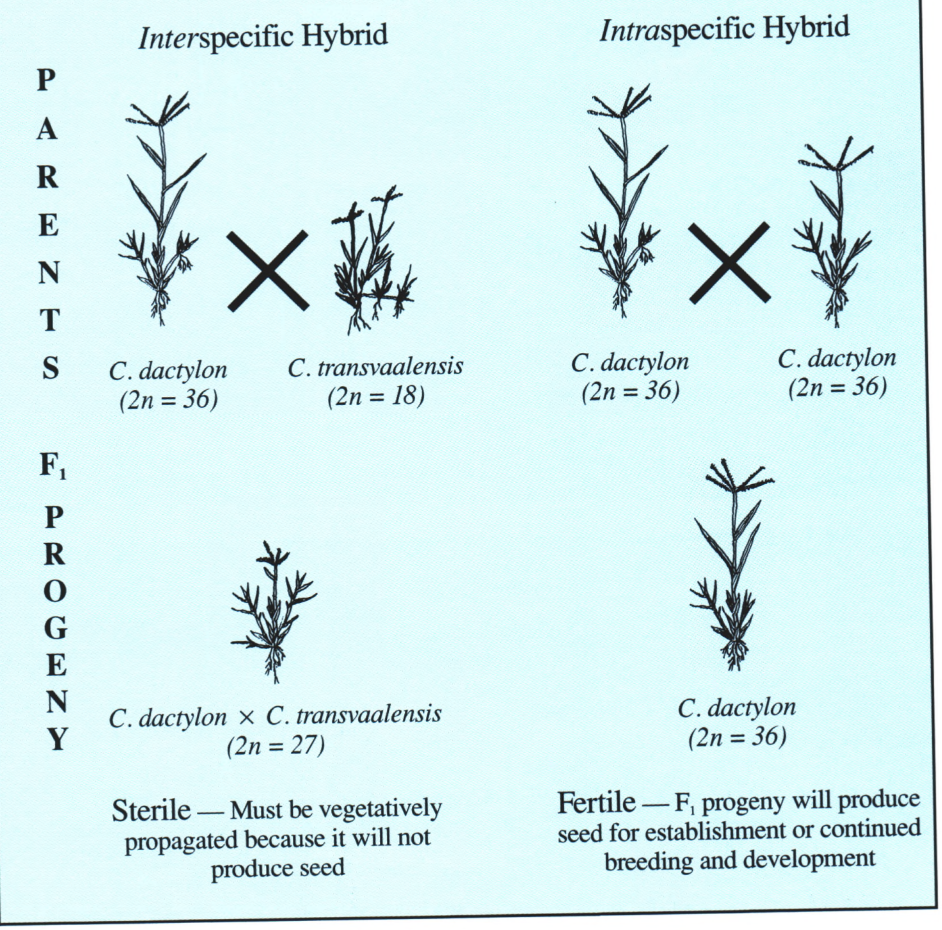


Table 1
Seed-Propagated Bermudagrasses Entered in the National Turfgrass Evaluation Program in 1986 and 1992†

1986	1992
*COMMON	*COMMON
*GUYMON	*GUYMON
*NM S-1 (NuMex SAHARA)	*NuMex SAHARA
NM S-3	*SONESTA
*NM S-2	*CHEYENNE
NM S-4	*SUNDEVIL
NM S-14	J-27
	J-912 (JACKPOT)
	FMC 1-90 (PRIMAVERA)
	FMC 2-90
	FMC 3-91
	FMC 5-91
	FMC 6-91 (SULTAN)
	90173 (MIRAGE)
	OKS 91-1
	OKS 91-11

† The 1986 test also included 21 vegetatively propagated genotypes for a total of 28 entries. The 1992 test included 10 vegetatively propagated genotypes for a total of 26 entries.

*Commercially available varieties.

sequent field experi than other multi- synthetic varieties. of these new hy appear to have goo cific combining a for the selected mo logical character and have moderate yield potential.

Basis for Hybrid Designation of The *Intra*specific Varie

Self-sterility, als ferred to as self-in patibility, is basic to ducing a high perce hybrid seed relativ self-pollinated see high amount of c fertility is also desi for seed set. Self-fer studies conducted on mudagrass indicate this characteristic v considerably from clone to another. H ever, most clones te have exhibited self tility of one or two cent expressed as see compared to cross- tility 20 to 30 ti greater. In a field isola study at Las Cruces, Mexico, the four pare clones involved in F 66 and FMC-88 set seed when self-po nated, but had mode seed set when allowe cross-pollinate. Seed measured while proc ing the two hybrids approximately 40 perc of the amount measu for the multi-clone s thetic variety NuM SAHARA.

Germination and Seedling Vigor

Germination and se ling vigor are often lov for seed of selfed pla (S_1 seed) compared to hybrid seed. In this ca S_1 seed from the f ones tested had considerably lower germination and reduced seedng vigor compared to ybrids. These results uggest that the selfed eedlings would not ompete well with the ybrid seedlings in solid ands. Also, the S_1 seedngs tended to be as fine r finer textured and less igorous relative to the ybrids and presumably vould not detract from urf quality.

Iniformity of Turf rom These Hybrids

Uniformity of the reulting turf is important or most turfgrass uses. ince the parent clones re heterozygous, there is enetic and morphoogical variability among he F_1 hybrid plants. The mount of morphological ariation among plants nay depend primarily on he gene differences etween the parent clones or such attributes as leaf ength and width, shoot longation rate, internode ength, and other characeristics. Therefore, uniormity within seed lots of an *intra*specific hybrid would not be expected to e as high as an *inter*specific hybrid, such as TIFWAY, since the latter was vegetatively propagated from a single plant.

However, FMC-66 and FMC-88 have been found to be very uniform morphologically even when individual progeny are evaluated in field plots. This high uniformity likely results from the previous development

Growth differences in bermudagrass varieties is evident only 45 days after transplanting.

Table 2
Summary of Turfgrass Performance of Four Hybrids, Three Synthetic Varieties, and Common Bermudagrass in Trials Conducted at Yuma, Arizona; Gainesville, Florida; and Las Cruces, New Mexico

Entry	Quality			Density			Texture		Color	
	AZ[1]	FL[2]	NM[3]	AZ	FL	NM	FL	NM	AZ	NM
FMC-66	7.8	5.9	8.0	8.3	6.0	8.5	4.0	7.5	6.9	7.5
FMC-88	7.5	6.7	7.7	8.3	6.3	8.0	3.7	7.0	7.0	7.5
TIFWAY	—	6.5	8.2	—	6.7	8.2	4.0	7.7	—	8.1
TIFGREEN	—	6.3	7.6	—	6.9	8.3	5.0	8.7	—	8.0
SULTAN	6.5	—	7.4	6.9	—	7.3	—	6.8	6.1	7.1
NuMex SAHARA	5.9	4.3	6.9	6.3	4.9	6.7	1.0	6.7	5.5	7.3
CHEYENNE	5.3	4.1	5.0	5.6	4.2	4.5	1.0	4.5	5.8	5.3
COMMON	4.8	4.8	4.9	5.0	4.8	4.7	1.3	5.5	4.5	6.3
LSD (P-0.05)	0.5	1.3	0.7	0.5	1.8	0.7	0.6	0.9	0.4	0.9

[1] Mean performance for two years at Yuma, AZ. Means were derived from three-replicate tests and 10 observation days from fall 1992 and spring 1994.

[2] Mean performance during 1994 at Gainesville, FL. Planted: October 1993. Data supplied by Dr. A. E. Dudeck, University of Florida, Gainesville, FL. MSD used instead of LSD for test of differences.

[3] Mean performance at Las Cruces, NM, in 1993. Means derived from three-replicate test.

NOTE: All plots were rated from 1 to 9, with 9 indicating highest quality, most dense, finest texture, and darkest green color, except texture ratings at Florida were 1 to 5, with 5 being most fine. Dash (—) indicates variety was not included in the test.

Table 3
Morphological Comparison of Three Hybrids, Three Synthetic Varieties, and Common Bermudagrass at Las Cruces, NM, in 1994*

Entry	Leaf Width mm	Leaf Length mm	Leaves/ Stem number	Leaf Density** number	Stem Diameter mm
TIFWAY	1.65	19.1	25.2	4.4	0.99
FMC-66	1.84	24.3	34.7	3.9	0.99
FMC-88	2.06	17.7	20.4	3.3	1.00
SULTAN	2.58	29.2	24.4	2.8	1.12
NuMex SAHARA	2.79	34.7	19.3	2.0	1.16
COMMON	2.80	51.4	17.4	1.7	1.03
GUYMON (Syn 2)	2.91	37.6	13.2	1.8	1.31
LSD	0.09	2.2	10.6	0.3	0.06

*Data from 90 individual plants (30 plants in each of three replications) established from seed, except for TIFWAY, where 90 vegetatively propagated plants were evaluated.

**Mean number of leaves per centimeter on first five nodes of stem measured from apical leaf.

ment and selection of parent clones that resulted in similar genetic backgrounds.

Genetic control for the seed crop of *intra*specific hybrids is enhanced over synthetic varieties with proper establishment, isolation, and maintenance of the two distinct parent clones. The F_1 seed harvested in subsequent years will be genetically identical since only F_1 seed will be produced.

Performance Results

Although these hybrids were not included in the *National Bermudagrass Test – 1992,* field evaluations have been conducted at several locations. Results indicate these hybrids produce a turf with significantly higher density and finer texture than the current generation of improved open-pollinated or multiclone synthetic seeded varieties. Both F_1 hybrids, FMC-66 and FMC-88, are more dense and have scored higher for turf quality than multiclone synthetic varieties in experiments at three locations across the United States (Table 2).

Additional performance data have been collected to better describe the two new *intra*specific hybrids and to compare them

Breeding Terminology

F_1	The first filial generation. The first generation of descent from a given cross or mating.
F_2	The second filial generation from a cross, such as the offspring from intercrossing F_1 plants.
ntraspecific hybrid	Progeny resulting from a cross of two individuals of the same species, such as *Cynodon dactylon* × *C. dactylon*.
nterspecific hybrid	Progeny resulting from a cross of two individuals of different species, such as *C. dactylon* × *C. transvaalensis*.
Clone	Identical organism descended asexually from a single ancestor, such as a vegetative stem or stolon of bermudagrass.
Progeny	Descendants or offspring from a mating or cross.
Hybrid	Offspring of genetically dissimilar parents (as members of different breeds or species).
Synthetic variety	Population of cross-pollinated plants or resulting seed from combining selected clones or lines.

h named seeded varieties and to the *inter*specific hybrid TIFWAY. af and stem characteristics, including leaf density, of 90 spaced nts of each genotype indicate large morphological differences ong varieties (Table 3). These quantitative data along with visual oring should help users better choose a variety for their needs.

ssibilities — Present and Future

*Intra*specific F_1 hybrids (2-clone single-crosses) that are seed opagated, such as FMC-66 and FMC-88, provide additional rieties for specific environments and uses. Although less dense or pen" varieties, such as NuMex SAHARA, are often scored lower turf quality, they may be the variety of choice for specific uations where drought resistance and lower density are desired. UYMON, although coarser textured, should be considered where nter killing is a problem. An *intra*specific F_1 hybrid, such as FMC-, with high density and fine texture may be the choice where better ll support for golf is desired.

Perhaps the most significant "bottom line" is that bermudagrass eeders are investigating new methods and providing users with ore choices in seed-propagated bermudagrasses.

cknowledgement

Some of the research leading to the feasibility and methodology sulting in the development of these hybrids was financed and couraged by the USGA Turfgrass Research Committee and the ew Mexico Agriculture Experimental Station. Support for graduate udent projects was especially significant.

STATEMENT OF OWNERSHIP, MANAGEMENT, AND CIRCULATION

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JAMES T. SNOW, Editor

LEONARD LEE RUE III

Wild turkeys and golf courses are a natural combinatio

ON COURSE WITH NATURE

Of Eagles, Birdies, and Turkeys

by RONALD G. DODSON
President, Audubon Society of New York State

FOR A GOLFER, there is no doubt that eagles and birdies rank high on the list of satisfying experiences. But what about the turkeys? Wild turkeys on golf courses? It's a *natural* combination. The wild turkey, an insect- and seed-eating bird, is found throughout the United States and northern Mexico, and is one of the largest birds in North America. Besides Thanksgiving and Christmas dinner, what do you know about turkeys?

An average adult male (called a tom or gobbler) can grow up to four feet long and weigh 18 pounds. The average female (hen) is much smaller, weighing only about nine pounds. Anatomical features are more prominent on the male turkey than on females. During the spring breeding season, the caruncles (wartlike growths on the neck) and the wattles (folds of skin below the beak) can turn fiery red, white, or blue, depending on the bird's mood. The snood is a flap of skin hanging down from the tom's beak. To help get the attention of a hen, the gobbler's snood will grow from about one inch to five inches! The beard is simply a bundle of special long, thin feathers. For the tom, all of these features are designed to prove to a female that he is a worthy mate.

Wild turkeys like company. Flocks of eight to ten turkeys form in the fall and winter. Generally, adult hens and their young of the year stay in one flock, while males come together to form "bachelor flocks." As spring approaches, the flocks break down and all of the groups join in large courtship flocks. They will stay together for about two to three weeks, when the hens move off to search for nest sites, followed by one or more adult gobblers. Mating takes place at this time. After mating, the males rejoin the male-only flocks until the following spring. Females then prepare their nests and take on all responsibilities for raising the poults (young turkeys).

Wild turkeys need diverse habitats that vary seasonally. They tend to be *habit generalists* — using several different kinds of plant communities during the year. During the winter, turkeys need high-energy foods. Acorns, beechnuts, and pine seeds are preferred, but under harsh winter conditions, waste grain will do. As spring arrives, wild turkeys move from their winter habitat t areas that are better suited to provide nestin and brood-rearing habitats. These habitat are often on the edges of hay fields, ol logging roads, fairways on golf courses, an thinned-out woodlots. For short distance wild turkeys are strong flyers. However, the spend more time walking. For short sprint they can reach running speeds of up to 1 miles per hour.

Proper management of your course woodlot, and grass areas can provide excel lent habitat for these magnificent creatures Because they're insect eaters and will con sume seeds from invasive vegetation, they'r great for your course's IPM program. They tend to be wary of people, so although you may see them from a distance or in transi from wooded area to wooded area, they tend not to be intrusive.

While you're out with your next four some and you happen to spot a turkey, use this opportunity to show off your gol course wildlife expertise. It may be almos as much fun as birdies and eagles to chal lenge them to describe a snood, wattle, o caruncle!

KEEP IT SIMPLE!

by BOB BRAME
Agronomist, Mid-Atlantic Region, USGA Green Section

KEEPING IT SIMPLE in golf course maintenance does not mean turning your back on modern technology. As an industry we have progressed a long way over the last few years. We cannot hide our head in the sand and survive for long. However, keeping it simple does mean *first things first*.

A truly successful golf course maintenance program is built on a solid foundation. This includes good water management (drainage and irrigation), a good grass-growing environment (sunlight, air movement, and a reasonable mowing height), and proper fertilization. At times, fine-tuning strategies are placed in front of a solid foundation. Think about these examples.

A plant growth regulator is being used as a means of reducing *Poa annua* in putting greens. The idea is to stunt the growth of *Poa annua* so that the stoloniferous, lateral growth of bentgrass will fill in and crowd out the *Poa*. Sounds like a reasonable strategy, right? Yet, when these same greens are being mowed *below* ⅛ inch, a contradiction occurs. At ultra-low cutting heights the mower will scalp down into the crown of the bentgrass plant. The weakened bentgrass is now more prone to disease, and the turf canopy is thinner, allowing weeds to encroach. *Poa annua* is given a green light. A proper mowing height is part of the foundation of a good maintenance program, and the use of a growth regulator is a fine-tuning strategy. Foundation elements must be in place to realize full value from fine-tuning strategies. Problems always occur when we get the cart before the horse.

New equipment innovations can help improve the playing surface for the game of golf, but new technology doesn't replace the required basics: direct sunlight, good air movement, and proper irrigation and mowing practices.

We are seeing more and more biostimulants being used in maintenance programs, sometimes by themselves and at times in combination with fertilizers. For the purpose of this discussion, let's assume they do enhance plant growth (there is some disagreement on this point, depending on the actual biostimulant being used). If they do create a growth response, how can you tell what is occurring because of the biostimulant and what is caused by the fertilizer? Biostimulants may have value, but anything that camouflages the superintendent's ability to monitor the growth response occurring from fertilization should be viewed as a potential problem. First things first.

We have a wide variety of tools (equipment and pesticides) available today for the maintenance of golf course turf. However, modern technology cannot replace the grass plant's need for direct sunlight and good air movement. It makes very little sense to invest time and money in the maintenance of quality turf and not provide the grass plant with what it needs to grow. If trees are blocking sunlight penetration, do some selective thinning. If underbrush is restricting air movement, remove it. The bottom line is that sunlight and air movement are foundation elements in producing healthy, stress-tolerant golf course turf.

Today's golf course superintendents are expected to wear a number of hats. Yet, it is the actual conditioning of the golf course for which the superintendent is ultimately evaluated. The pressure for perfection has, more than once, caused well-meaning superintendents to shoot themselves in the foot (I've been there, and I've seen others do it). Keeping it simple would suggest making sure your foundation is solid before trying to fine-tune. During the heat of battle, stay with what has worked in the past. When in doubt, don't do anything! Keep it simple.

TURF TWISTERS

MORE POROUS SOILS

Question: We plan to *cap* the fairways on our new course with a material that is much more porous than the underlying soil. Do you foresee any major problems? (Wisconsin)

Answer: You may create seepage areas near the base of slopes because of the different permeability rates of the soils. Water can easily enter the surface layer but not the lower layer, so it will flow downhill, underground, until it is forced to the surface by some obstruction or because of soil saturation. Interceptor drains placed across the slopes should minimize the problem. Ditches must be cut into the dense soil and drainage tubing should be imbedded into gravel to be effective.

MAKE FOR SUCCESSFUL

Question: We've had a difficult time developing appropriate fairway contours. We have information on proper widths and advice from an architect; however, every time we try to mow the new contours, it looks terrible! Do you have any advice? (Connecticut)

Answer: Get several hundred yards of yellow or white rope, and use the rope to outline the proposed contours. You can then stand on the tee or landing area and hit golf shots to actually experience the new contours. If you don't like them, move the rope! After you have agreed upon the new contours, simply use marking paint to outline the contours to guide the fairway mower operator.

LEACHING OF SALT ACCUMULATIONS

Question: Salt accumulation on my native soil greens is a big problem, especially during the summer. I know I need to leach the soil, but my soil percolation rates are so low I can't apply enough water to do any good. Is there anything else I can do? (California)

Answer: For optimum results, try to schedule leaching operations in conjunction with putting green aeration. Deep-tine aeration in the spring, and additional aeration during the summer using ¼" to ⅜" hollow tines may be necessary if the problem is severe. Another option may be to schedule several short irrigation cycles during the night at repeated intervals. Be sure to allow time between the cycles to allow the water to percolate into the soil profile. If your irrigation system cannot apply water at a slow enough rate, try placing a low-precipitation-rate sprinkler on the green for a period of four to six hours. A lawn-type stream rotor sprinkler placed on a stand and connected to a quick-coupler valve works well for this purpose.