USGA® GREEN SECTION

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*Cover Photo:
Many factors need to be evaluated to determine the overall performance of the golf green.*

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Using a contractor can eliminate the need to purchase expensive, state-of-the-art equipment when products require special application methods. *See page 10.*

MSMA is being used to control paspalum encroachment (dark brown) into Tifgreen bermudagrass. *See page 17.*

Helping Your Greens Make the Grade

Here's a guide to help you evaluate the many factors that determine how your greens perform.

by JAMES FRANCIS MOORE

Reduced sunlight results in decreased photosynthesis and therefore reduced plant vigor. Problems are compounded by low-cut greens that have very small leaf area available to gather light. Moss invasion on a green is an indication that the proper environmental conditions aren't present to grow good turf.

GOLFERS and their greens have had a long and often tumultuous relationship. In fact, no area of the course has a stronger influence on the golfer's game, since between the approach shot and putting, the greens come into play on approximately 75% of the shots of a typical round of golf. Most golfers realize this and are quick to point their putters in disgust whenever the green does not act as they believe it should, and they brag to their neighbor when their club's greens are in top form.

Golf course superintendents and their greens have an even greater love/hate relationship. There is an old saying in the superintendent's world — "Your greens are your resume." True enough, since players overlook a great deal on the course when the greens are in good shape, but will call for the superintendent's head when the putting surfaces are less than perfect (regardless of how good the remainder of the course is). The golfer's perception of the role of the superintendent in providing perfect greens is reflected in the tendency of the weekend hacker to refer to the *superintendent* as the *greenkeeper* — a term poorly suited to describe the varied and often complex duties of today's professional golf course superintendent.

Since golfers and superintendents alike have such close relationships with their greens, it is beneficial for all concerned to have a better understanding of why greens perform the way they do. Truth be known, few golfers have any idea of the various factors that determine the overall performance of the green. They hear stories of mysterious turf diseases and bugs, and most know they should generally fear terms like *Poa annua*, goosegrass, and brown patch. But for the average golfer the *pest* most feared is the aerifier. And while superintendents spend many hours studying the agronomics of maintaining greens, they are occasionally guilty of putting the needs of the turf over those of the golfer. The best superintendents recognize the need to seek a middle ground — to establish a level of maintenance that results in a healthy stand of turf but still provides good putting quality. Obviously, the establishment of this *middle ground* should be the golfer's goal as well, since this is their best hope of playing greens that perform well day after day. Finding the middle ground is the purpose of this article.

Greens usually do not perform well or poorly because of a single factor. Instead, like most things, overall performance is the result of many influences. To identify these factors, it is suggested a *Report Card* be developed for each green. This Report Card will graphically illustrate where improvement is needed.

Quite simply, the Report Card is a *tool* to help golfer and superintendent alike evaluate the many factors that influence the overall performance of each green on their course. After the factors are identified and quantified, steps should be taken to improve each factor as much as possible. It probably will not be possible to bring each factor (or perhaps even any factor) up to a grade of "A." For example, on old or poorly built greens the factor for internal drainage may be graded as a "D." Through an aggressive aerification program the grade may be raised to "C," but only complete reconstruction would achieve the "A" rating. However, it may be possible to raise the grades for other factors as well. Perhaps entrance and exit points can be improved by rerouting a cart path or making greater use of ropes and signs. Air movement may be improved by removing brush or trees that block the wind. The relocation of misplaced sprinklers could improve the accuracy of irrigation. The overall impact of raising three or four factors will be a significant reduction in the influence of a factor that cannot be altered. In other words, the overall performance of the green can be expressed as a simple formula: The Average of Factors $A + B + C + D + E \ldots$ = *Overall Green Performance.*

Think of each green as a decathlon competitor. An athlete whose height may limit his or her ability to high jump will have to make up points on the 200-meter dash to remain competitive. There is another formula you should keep in mind regarding the changes that are made to improve the greens. This is a case where $1 + 1 + 1 + 1 + 1$ can actually add up to 6. In other words, by implementing multiple changes (each reducing the stress on the green), a synergism is likely to occur, reducing overall stress by more than the sum of the individual steps. This is due to the fact that so many of the stress factors are closely related. Improving one factor frequently results in improvement in one or more of the others.

To be the most useful and effective, the Report Card must be developed with the combined input of the golf course superintendent, course professional, and members of the course leadership (often the Green Committee). This group is referred to below as the *Rating Team*. There are three steps to completing this evaluation process.

Step 1

Assign an overall performance grade to each green. Before heading out to the course, the Report Card rating team should first gather in a comfortable and private area to discuss what lies ahead. This is also the time to complete the first phase of the Report Card — assigning a letter grade to each green's overall performance. Just like in school, a grade of "A" reflects superior performance, and "F" indicates failure. This overall grade is much like a college student's final GPA

Layers in the green profile severely restrict internal drainage and can even block it altogether. Conventional aerification may not be deep enough to fully penetrate a buried layer. Deep-tine aerification is the next step in solving the problem.

or grade point average over four years of education. Be sure not to base the overall grade on a single good or bad season. Base the grade on four or five years' worth of performance.

Step 2

Visit each green to complete the Report Card and identify where changes should be made. This is where the evaluation process gets more detailed. Listed on the accompanying rating sheet are many factors, each of which should be assigned a letter grade. Notice that the sheet has room to add additional factors. It also is possible that some of the factors listed are not applicable to your particular course. Since the grades are obviously subjective, it is important that the entire rating team participate in the evaluation process from start to finish. It is also advisable to complete the process in a single day. Based on personal experience with this rating concept, 18 greens should take approximately three hours to rate fairly.

Step 3

Implement the changes. The Report Card is useless unless changes are made to improve the overall growing conditions on the greens. Implement as many positive changes as possible, keeping in mind that no single change will have the impact of multiple changes.

Factors Influencing a Green's Performance

Listed below are the factors that have the greatest impact on the overall performance of a green. (Note that they are not listed in any particular order.) Also included are some criteria for determining a grade for each factor. It should be viewed as a starting point and not an inflexible guide that must be followed to the letter. Your rating team probably will find it helpful to modify the criteria to better fit your course.

Light

A basic agronomic fact that is overlooked far too often is that turfgrass requires light (lots of it) to flourish. As you rate each green for light, keep in mind what you probably learned back in the fourth grade. Light is necessary for photosynthesis. Photosynthesis is the process of turning the energy of light into energy the plant can use for growth. Growth is necessary for a plant to withstand and recover from wear and tear. Therefore, it stands to reason that when less light is available, the turfgrass is less able to withstand traffic.

The steps to improve the grade for light are obvious. Tree pruning, and in some cases complete removal, will be necessary to provide better growing conditions. It is easy to forget that trees grow larger every year and as a result block more light each season. Keep this physiological fact in mind when someone observes, "We never used to have problems with that green."

• "A" — given to greens that receive 8 hours or more of direct sunlight.

• "B" — given to greens that receive 6 to 8 hours of direct sunlight.

• "C" — given to greens that receive 4 to 6 hours of direct sunlight.

• "D" — given to greens that receive 2 to 4 hours of direct sunlight.

• "F" — given to greens receiving less than 2 hours of direct sunlight.

Air Movement

Air movement across the putting surface has a very strong influence on the overall health of the turf — particularly in terms of disease susceptibility and cooling of the plant. The pathogens responsible for the most devastating turfgrass diseases are far less active (and therefore less destructive) when air moves immediately over the turf. The air movement helps keep the turf and the surface of the soil dry. Wet, stagnant air provides excellent conditions for pathogens to proliferate. From a cooling standpoint, a good comparison can be made to our built-in air-conditioning system — perspiration. On a hot day, our skin is cooled as we perspire. The plant's perspiration system is called evapotranspiration (a combination of evaporation and the transpiration of water through the stomata or *pores* of the leaf). Air movement must be given high priority for all greens — particularly on golf courses located in climates that include high heat and humidity.

Steps to improve air movement include pruning and possibly removing trees and brush on the upwind and downwind sides of the green. When tree removal is considered to be impossible because of architectural or sentimental reasons, institute an effective pruning program. Even high mounding around a green can block air movement, so regrading the mounds can produce a significant improvement. In severe cases, fans are used to provide an artificial source of air movement.

• "A" — given to greens that receive unrestricted air movement across the turf surface.

• "B" — given to greens that are blocked from the predominant winds but open on other sides.

• "C" — given to greens that would receive very limited air movement without the use of fans.

• "D" — given to greens "open" on only one side.

• "F" — given to greens located in low areas that receive extremely limited air movement from any side.

Entrance and Exit Points

Codes for buildings call for a specific number of entrances and exits based on the capacity of the building. Perhaps greens should be given the same consideration. When the architecture of a greensite is such that entrance and exit points are severely limited, even a small annual number of rounds can be quite destructive to the turf. Greenside mounding, bunkering, trees, and other features can be as restrictive as cattle chutes. Predictably, such restrictions are far more important on heavily played courses than on the extremely private facility.

Steps for improvement include rerouting cart paths to encourage players to enter and exit from different sides of the green. Ropes and signs often are necessary evils (but be sure to move them frequently and keep them in good condition). In severe cases, bunkers may have to be removed or redesigned to provide greater access to the green. Mounding may have to be softened, since players instinctively avoid walking over hills to get to the green. Inconsiderate players might ignore all these efforts to spread traffic out over a large area. However, the majority of golfers realize they benefit the most from a course in good condition and will cooperate with properly placed and maintained traffic control devices.

• "A" — given to a green that has at least four readily usable entrance and exit points.

• "B" — given to a green that has three readily usable entrance and exit points.

• "C" — given to a green that has only two readily usable entrance and exit points. Other access points exist but will require extensive roping and/or signage to force players to use them.

• "D" — given to a green with only one readily usable entrance and exit point. Other access points may exist but require extensive roping and/or signage to force players to use them.

• "F" — given to a green with only one readily usable entrance and exit point and no other real options, regardless of roping, etc.

Size of Green

Golf has enjoyed tremendous growth over the past couple of decades. As a result, the greens on many courses must endure countless additional rounds. In many instances, the original architectural design that was appropriate in the early days of the course simply cannot support the twofold or even threefold increase in annual rounds that is not uncommon today. Just as many families start out driving a two-seater, these families often find themselves driving station wagons ten years later.

Steps for improvement are limited. Since greens sometimes grow smaller over time (as the workers on the mowers try to avoid scalping the edges), it is possible that the original boundaries of the green can be reestablished, providing additional square footage. A probe should be used to find the original edge of the rootzone

Often, something as simple as eliminating triplex mowing in favor of walk-behind can be enough to help a green through the rough times.

cavity. It should be noted that even if the green has grown it, enlarging the surface may take a lot of effort. For example, in areas of the country where bermudagrass fairways and banks surround bentgrass greens, simply enlarging the mowing pattern would likely introduce bermudagrass into the bentgrass green. In this situation, fumigation of the bermudagrass in the area to be recovered as green should be accomplished first.

• "A" — given to a green in excess of 7,000 square feet.

• "B" — given to a green 6,000 to 7,000 square feet in size.

Triplex mowers on sharp turns can result in severely worn turf. Simply changing to walk-behind mowers may be enough to return the turf to good health.

• "C" — given to a green 5,000 to 6,000 square feet in size.

• "D" — given to a green 4,000 to 5,000 square feet in size.

• "F" — given to a green less than 4,000 square feet in size.

Cupping Area

Another factor that has been strongly impacted by the increase in the popularity of the game (and therefore increased traffic on the greens) is cupping area, or the number of areas in which the hole can be *fairly* located. As a general rule, the hole should be located approximately five paces from the edge of the green, and the putting surface within three feet of the hole should be on the same plane.

Estimating the percentage of the green that is usable for hole locations takes a little practice. To develop a feel for this estimating process, try the following procedure on the first couple of greens rated. Using tees, roughly outline the portions of the green in which the hole can be reasonably placed. Next, estimate the square footage of each marked area. Add the square footage together and divide the sum by the total square footage of the green. For example, suppose there are three areas of the green that can be used for hole locations. The total square footage of these three areas is approximately 1,500 square feet. The entire green measures 6,000 square feet. 1,500 ÷ 6,000 = .25 or 25%.

Steps to increase cupping area include the restoring of original green boundaries (as discussed above in the "Size of Green" section) and selecting a speed for the greens that is appropriate to their contouring. For example, a green mowed at ⅛ of an inch and rolling 9 feet on the Stimpmeter may yield a rating of "D." Raising the cut to 5/32 inch might yield a speed of 8 feet and increase the percentage of usable cupping area to a "C" or even "B" rating.

Assuming greens are moderately sized to begin with, use the following grades to rate cupping area:

• "A" — given to greens with cupping areas in excess of 50%.

• "B" — given to greens with cupping areas between 40% and 50%.

• "C" — given to greens with cupping areas between 30% and 40%.

• "D" — given to greens with cupping areas between 20% and 40%.

• "F" — given to greens with less than 20% cupping area.

Surface Drainage

Surface drainage is extremely important to every green, including those with good internal drainage. Even the best-constructed rootzone will gradually drain more slowly. This is due to the production of organic matter by the plant and the introduction of soil *fines* (notably clay, silt, and very fine sand) into the rootzone over the years. These fines are introduced through topdressing, wind, and even during irrigation when the water supply contains suspended solids. It is even possible for some types of sand to be chemically weathered, causing a reduction in size.

Without good surface drainage, water collects in the low areas of the green, resulting in extremely poor growing conditions for the turf. The rootzone becomes saturated and can remain that way for extended periods of time. This results in anaerobic (without oxygen) conditions, which can lead to the death of the plant. Disease incidence also increases, as does the occurrence of algae and soured soil (often referred to as *black layer*).

Surface drainage occasionally can be improved by lifting the sod, adding additional rootzone mix to eliminate the water-collecting hollow, and replacing the sod. Obviously, this step is practical only in small areas and near the edges of the green. Sometimes surface drainage is blocked by the development of thick thatch in the turf immediately adjacent to the green. Removal of the sod and thatch, followed by replacement with a thatch-free sod, may be all that is necessary to allow water to once again flow off the green.

• "A" — given to greens with no water collecting hollows and surface drainage in at least three directions.

• "B" — given to greens with no water collecting hollows and surface drainage in two directions.

• "C" — given to greens with no water collecting hollows and surface drainage in one direction.

• "D" — given to greens with surface drainage to the center of the green and one surface exit point.

• "F" — given to greens with water collecting hollows.

Internal Drainage and Rootzone Porosity

Internal drainage and rootzone porosity are often the only factors considered when determining the need for the complete reconstruction of golf greens. The USGA provides specific guidelines regarding these factors (see the *USGA's Guidelines for a Method of Green Construction*). However, all too often greens will be rebuilt to meet these guidelines without consideration of the many other factors that contributed to the poor performance of the original green. Not surprisingly, in many instances the new green does not perform as well as expected. Internal drainage and porosity are extremely important, but they cannot compensate for the lack of light, poor air movement, poor traffic control, etc.

Good internal drainage is without question very influential to the overall performance of the green — particularly in adverse climates and in areas where water quality is less than ideal. The degree of internal drainage is measured as *saturated hydraulic conductivity.* Rootzone porosity represents the sum of two types of porosity — *capillary* and *non-capillary.* Capillary porosity is a measure of the percentage of pores in a rootzone mixture that are filled with water at field capacity, while non-capillary porosity refers to the percentage of pores filled with air. To determine these factors accurately, samples should be removed from the green and submitted to an accredited physical soil testing laboratory.

Short of complete reconstruction, the most effective means of improving internal drainage and porosity is to increase aerification. Often, a combination of deep-tine and conventional core aerification is necessary. Many courses now include water-ject aerification as a supplement to the mechanical aerification practices.

- "A" — given to greens built in accordance with USGA guidelines.
- "B" — given to non-USGA greens with hydraulic conductivity rates over 3 inches per hour and a functional subsurface drainage system.
- "C" — given to greens with hydraulic conductivity rates over 3 inches per hour but no subsurface drainage system.
- "D" — given to greens with hydraulic conductivity rates of 1 to 3 inches per hour.
- "F" — given to greens with hydraulic conductivity rates of less than 1 inch per hour.

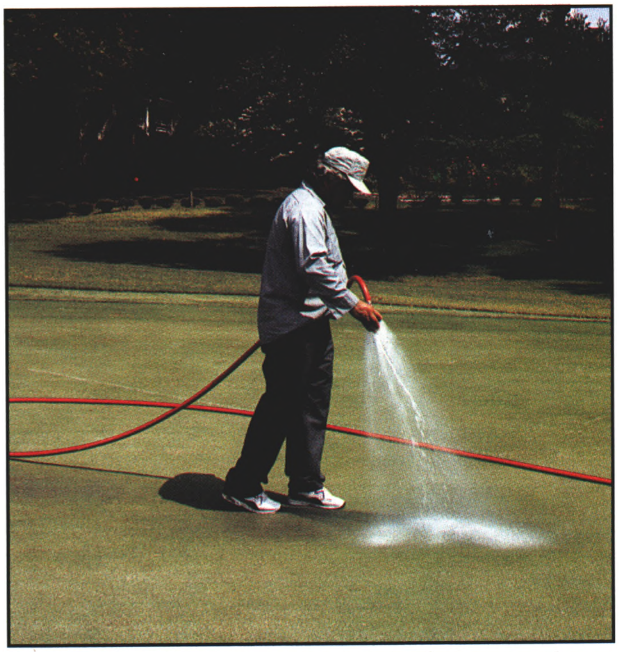
Good air movement across the putting surface is vital for disease suppression and plant cooling. If tree pruning or removal is not possible, fans are the next best option.

Irrigation Control and Coverage

This is another area that frequently is overlooked when evaluating the overall performance of greens. Although proper irrigation has always been important, the lowering of cutting heights and the use of different grass species in the vicinity of the greens has enhanced the need for as much control and accuracy as possible. Common sense should make us wonder how full-circle, overhead sprinklers that cover the green, surrounds, and fairway approach areas, can possibly meet the specific needs of the turf in each area. For example, a bentgrass or bermudagrass green maintained at $\frac{3}{16}$ inch or less does not conveniently have the same water requirements as the bermudagrass fairway cut at ½ inch or the bluegrass rough mowed at 2 inches. Different cutting heights and different turfgrasses demand different irrigation frequencies and volumes. As a result, even a well-designed and properly installed and operated system often must be supplemented with hand watering. And, obviously, a system with poor spacing, improper nozzles, or improper pressure adjustments will cause nothing but problems.

Steps for improvement include upgrading the irrigation system to provide single head control, installing a perimeter system to water the surrounding turf separately from the greens, relocating heads to provide even coverage, and altering nozzle sizes to achieve better coverage and proper pressure regulation. Hand watering can also be increased to help compensate for a substandard irrigation system.

- "A" — given to greens irrigated with a combination of full-circle and adjustable part-circle heads facing outward. Such a system is often referred to as a *perimeter* system. Each of the heads should be able to be controlled independently through the automatic irrigation system.
- "B" — given to greens without a perimeter irrigation system but with single head control of sprinklers that are correctly spaced.
- "C" — given to greens without a perimeter irrigation system and without single head control.
- "D" — given to greens with no perimeter system, no single head control, and the satellite that controls the greens is located on the same irrigation cycle as other areas of the course.

Good employee tenure usually results in a better-trained crew. Knowing the difference between cooling the turf and spot watering, and when each technique is needed, can result in better-managed turf during stress periods.

• "F" — given to greens with a manual irrigation system.

Purity of Turf Stand

Older greens are often composed of more than one species of turfgrass and even various biotypes of the same grass. For example, older bentgrass greens often have large percentages of *Poa annua* intermixed with the bent. Biotypes of both bentgrass and bermudagrass in greens begin to segregate over time, resulting in many patches of distinctly different grasses in the same green. Each of these different grasses and biotypes has a particular set of vulnerabilities to insects, disease, climatic stresses, and, particularly, cutting heights. As a result, the more varied the makeup of the putting surface, the more difficult it is to manage.

With the exception of very minor outbreaks of *Poa annua* and/or off-type grasses, there is little that can be done to restore the purity of the stand of grass other than completely replant. Until then, raising cutting heights to suit the type of grass in the green that is least able to tolerate low cutting heights will help provide uniformity in terms of putting quality.

• "A" — given to greens composed of a pure stand of turf.

• "B" — given to greens with less than 20% "off" types.

• "C" — given to greens with less than 30% "off" types.

• "D" — given to greens with less than 40% "off" types.

• "F" — given to greens with less than 50% "off" types.

Amount of Play

No agronomic mysteries here — the less you use your greens, the healthier the turf will be. When golfers make their inevitable comparisons from one course to the next, the amount of traffic the greens must endure often is the most overlooked factor.

To deal effectively with traffic, it is vital the greens be established to the best turf for the climate in which the course is maintained. What is agronomically possible does not mean it is agronomically sensible. Bentgrass greens maintained in hot and humid climates cannot tolerate the same amount of play as bermudagrass greens in the same climate. The superintendent also should be sure that adequately high cutting heights are maintained to *cushion* the turf from heavy traffic loads. Topdressing, fertilizing, and grooming practices must be adjusted to maintain a pad or thin layer of organic matter between the crown of the plant and the underlying (usually abrasive) rootzone mixture. Potassium levels should be kept at recommended levels to provide a stronger plant that is better able to withstand stress. Spikeless shoes should be encouraged to reduce injury to the turf.

• "A" — given to greens that receive fewer than 20,000 rounds per year.

• "B" — given to greens that receive fewer than 30,000 rounds per year.

• "C" — given to greens that receive fewer than 40,000 rounds per year.

• "D" — given to greens that receive fewer than 50,000 rounds per year.

• "F" — given to greens that receive more than 50,000 rounds per year.

Water Quality

The water used to irrigate the greens can make the difference between success and failure of the turf. Greens maintained with water high in salts or bicarbonates are predisposed to a wide variety of problems. Establishing a grade system for water quality is impossible, since so many factors interact. If you have questionable water quality, it is best to solicit the input of a qualified agronomist to determine the impact of the water on the turf, as well as steps for improvement. The ratings listed below are therefore highly generalized.

• "A" — excellent water quality.

• "B" — good water quality.

• "C" — marginally acceptable water quality.

• "D" — poor water quality.

• "F" — very poor water quality.

Other Rating Factors

There are many other factors that may need to be considered by the rating team. These could include the following:

• Nematode levels.

• Experience and skill of maintenance crew.

• Availability of proper maintenance equipment.

• Tenure and skill of the superintendent.

• Tree root competition.

• Cutting height.

Rating the skill of the superintendent is perhaps the most subjective process of all. Without question, a skilled superintendent who has been given time to learn the nuances of a particular set of greens can have a very positive impact on the overall performance of those greens. However, no superintendent, regardless of skill, can completely overcome stresses resulting from the many factors discussed earlier. The superintendent cannot independently provide light, air movement, adequate size, drainage, or good water quality. Assuming your course has a superintendent of at least average ability, the team would be wise first to correct the many other factors that are holding back the greens. It is amazing how often a superintendent considered by the golfers to be without talent suddenly develops a green thumb when given the opportunity to manage properly constructed greens. By the way, there are steps to take to help the superintendent improve as well. The leadership of the course should support the superintendent's efforts to learn by providing the opportunity to attend educational sessions on national, state, and local levels. The science and art of greens management changes rapidly with the introduction of new technologies and the ever-increasing stresses today's greens must endure.

Conclusion

Developing the Report Card can identify where work is needed to improve the greens. It can also help determine whether or not reconstruction is necessary. Finally, completing the Report Card before building or rebuilding greens can help ensure that, when the construction is finished, the greens will be both agronomically sound and capable of providing top-quality putting conditions.

JAMES FRANCIS MOORE *is Director of the USGA Green Section's Construction Education Program.*

Table 1

Report Card for ______________________ Date Completed ______________

FACTOR	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Light																		
Air movement																		
Entrance and exit points																		
Size of green																		
Cupping area																		
Surface drainage																		
Internal drainage																		
Irrigation control/coverage																		
Purity of turf stand																		
Amount of play																		
Water quality																		
Historical Performance																		

How I Spent My Summer Vacation

A few thoughts on what to do when your worst nightmare becomes reality.

by SCOTT CARPENTER

I WAS JUST BEGINNING to believe everything was in place for a great season, but on the evening of July 17th, someone felt compelled to lash out at Brooklake Country Club and its members. Vandals attacked and tried to destroy several of our greens. Using a form of industrial paint thinner and what we believe was a watering can, the vandals poured the material in wide, sweeping arcs on six different greens. Ultimately, they were successful in destroying the majority of the turf on our 2nd, 5th, 6th, 8th, 12th, and 14th greens. Hopefully, you will never have to deal with this type of a situation, but being prepared for the worst is always a good idea. The purpose of this article is to pass on some of the lessons we learned in dealing with our difficult situation.

The damage was discovered early on the morning of July 19th, 1996, and we quickly developed our initial plan of action. The following steps were taken to halt the damage and encourage recovery.

- The greens were triple cut with the goal being to remove as much contaminated leaf tissue as possible.
- Activated charcoal was applied in the hope it would act as a neutralizer and absorbent.
- The club president, board of directors, and golf professional were notified immediately and kept informed as to the extent of the damage and what we were doing to rectify the problem.
- Local law enforcement personnel and our insurance carrier were notified.
- Measurements and photographs were taken to document the depth and extent of the chemical damage.

The damage initially appeared minimal (slight yellowing in streaks, 1 to 2 inches in width); however, within 24 hours, the real damage became dramatically apparent. It was evident that the chemical applied was extremely mobile, as the plume of damage expanded in all directions. The initial thin streaks developed into much larger areas, with the affected turf being totally destroyed. The loss of turf quickly affected playability, and by August 8th, three weeks after the incident, we were forced to close all six greens.

Overwhelmed by the nature and extent of the damage, we quickly realized that outside consultants would be necessary to help us with the unique challenge. We began speaking with experienced superintendents, our USGA agronomist, environmental engineers (specializing in soil remediation), the Rutgers University Plant Diagnostic Laboratory, soil scientists, and even our golf course architect.

Since characterizing the compound would greatly aid our efforts to neutralize it, our initial goal was to identify the chemical compounds through field testing with a Photo Ionization Detector (PID). These tests revealed elevated levels of volatile organic vapors and helped set parameters for further laboratory testing.

Composite soil samples were then taken from all six damaged greens, and laboratory test results revealed the presence of acetone, butyl alcohol, and methyl tert butyl ether compounds. These compounds are commonly associated with industrial paint solvents. Although the compounds were found in relatively low concentrations, they proved extremely toxic to the turfgrass.

The compounds identified are extremely volatile. This characteristic was considered beneficial since this would lead to reduced persistence in the soil. We assumed that opening up the soils through aerification would allow more of the chemicals to volatilize, so the affected greens were aerified on July 29th, August 5th, and again on August 26th. The cores were removed in each instance and our traditional 90:10 topdressing material was applied in sufficient quantity to thoroughly fill the holes. The greens also were seeded at a rate of 2 lbs./1000 sq. ft. following the July 29th and August 26th aerifications. Additional samples were then sent to the Rutgers University Plant Diagnostic Lab and placed in growth chambers for evaluation.

Base levels of contamination were established on August 1st. Weekly results of the PID scanning and composite soil samples analyzed thereafter revealed that contamination levels in the soil were dropping steadily. Some of the compounds were no longer detectable. Visible signs that our efforts were producing positive results included germination of seed and limited recovery of surrounding turf. Unfortunately, recovery was slow and somewhat inconsistent.

Membership pressure mounted in late August, and the board of directors became concerned about the prospect of losing outings and their associated revenue. Thus, a decision was made to sod the damaged greens.

With sound planning and excellent cooperation between our sod supplier and local installation contractor, the sodding project proceeded smoothly. The existing sod and approximately 2 inches of underlying soil were removed in the process. Additional topdressing was added to bring the surfaces back up to grade. Installation of the creeping bentgrass sod began on the 13th of September and finished on the 16th. The new sod established rapidly with cultural practices that included several rollings and weekly Hydrojecting and regular mowing beginning 2½ weeks after installation. Starting on October 7th, the greens were aerified twice on 3-week intervals. Deep vertical mowing also was performed. Following the first frost, geotextile covers were used to extend the growing season.

Sod establishment went well, though on several occasions that fall, *ghosting* appeared in the same patterns as the damage. The appearance of the ghosting seemed to coincide with turfgrass stress. This caused considerable concern, since it showed that some of the chemicals were still present in sufficient quantity to cause turf damage, even though they were not being detected by the sampling methods. One possible explanation posed was that radical change in hydrologic pressure forced contaminants upward in the soil profile. Not wanting to cause unnecessary damage to the healthy turf, we decided to deep-aerify the affected areas only. This was done by hand, using hand drills equipped with ¾" × 14" ship auger bits and a template we manufactured from plywood with a 2" × 2" hole pattern. The soil brought to the surface was removed and the holes were back-filled with a 6:2:2 topdressing mixture of sand, soil, and compost. The intent was to remove soil with lingering contamination, increase aeration, and provide additional adsorption sites for any remaining chemicals. Essentially, we vertically mulched the areas where the ghosting had appeared. The procedure seemed to be successful, since little ghosting appeared thereafter. The greens were finally reopened on a limited basis on May 1st, 1997. They were returned to normal operation on June 1st.

It was not until the catastrophe was behind us that we had an opportunity to stop and reflect on all that had occurred. The vandalism was extremely unfortunate and it caused a tremendous amount of expense, not to mention disruption to the golf schedule. The experience was exhausting and frustrating for me and the entire maintenance staff. Nonetheless, some valuable lessons can be learned from it all, and there are a number of things to do in the event a catastrophe occurs at your golf course. The following are a few of the strategies that helped us.

A superintendent's worst nightmare is to deal with damage caused by the unknown. Vandals poured solvents onto several greens at Brooklake Country Club, causing tremendous damage to the turfgrass and contamination of the soil. The staff spent the following weeks with a combined arsenal of maintenance techniques trying to correct the damage.

• Maintain an accurate *written chronology of events* and be sure to take plenty of photographs. This method was a very useful tool, which we referred to continually. All pertinent events should be recorded, including remediation techniques and options, conversations with consultants, weather records, etc. It is essential to keep accurate records for a variety of reasons, and with everything happening so quickly, it is impossible to do so without a journal. Simply listing pros and cons was helpful in gaining perspective.

• *Use consultants* and pool their information. Our situation was not typical and there was no cookie-cutter solution. However, the free flow of information and ideas helped us to fabricate a solution that suited our needs.

• *Maintain a strong public relations campaign.* Within days, numerous members of the community and club members had questions and concerns as to how the disaster occurred and who might be responsible. After a week or so, the dialog shifted to how we could effect a quick recovery. Professionals from all walks of life offered opinions and solutions. I tried to keep all discussions as polite, cordial, and positive as possible. However, repeated in-depth conversations can be very taxing, especially when combined with the stress and strain of a difficult situation. Detailed discussions are often best reserved for people directly involved in the decision-making process. Brief articles describing the situation and what you are trying to do to resolve it, even in outline form, can help keep the golfers informed. This also is a good means of reducing the wild speculation that frequently accompanies catastrophes.

• *Do not get tunnel vision.* Explore every possible option and scenario, and be sure to keep your contractors informed. Although reestablishment from seed was our first approach, we made tentative arrangements with a sod grower and golf course construction contractor in the event that our initial efforts proved unsuccessful. They were extremely cooperative, and little time was lost when the decision was finally made to sod the greens.

• *Communicate openly and honestly* with your board of directors, owners, etc. In our situation, there were many unknowns and the best course of action was rarely crystal clear. Having to state that "this appears to be our best option" was an unnerving and humbling experience.

• *Insurance: Real property* is a term used by insurance underwriting and it should be clearly defined. Make sure that in your policy greens, tees, and fairways are included as Real Property. Develop and discuss a specific protocol for repairing the damage with your insurance carrier up front. Even though we communicated with our carrier, problems still occurred when our claim was ready to be settled.

• Finally, *remain positive.* They say hindsight is 20/20. Our foresight through these trying times was just as good. On a personal note, try to keep everything in proper perspective. Try not to allow an overwhelming problem consume all your thoughts and cause you sleepless nights. Keep in mind that you, as the superintendent, are part of the equation for the solution rather than the problem, as some may make you feel.

SCOTT CARPENTER *is the golf course superintendent at Brooklake Country Club in Florham Park, N.J.*

More superintendents are relying on contractors to make bulk fertilizer applications. Their equipment is more accurate, the work is done at a minimal cost, and the job is completed ahead of morning golfers.

BRINGING IN THE HIRED GUNS

Contract services can help streamline maintenance operations.

by PAUL VERMEULEN

IN OLD WESTERN FILMS where unsavory bandits and cattle rustlers ruled the landscape, worried homesteaders payrolled hired guns to protect their farms and families. And like the vulnerable settlers of yesteryear, modern-day superintendents can also take advantage of hired help to complete atypical tasks on the course. Where services are available, employing a contractor may streamline a maintenance operation by reducing labor and equipment costs, providing substitutes for temporary laborers, decreasing the potential for personal injuries, and lessening employee training time. Superintendents may also become more popular around the ol' watering hole by hiring a contractor to get a few big jobs done ahead of morning play.

Like gunslingers who spent hours practicing their quick draw on desert cacti, contractors who specialize in non-routine tasks become more proficient, and can finish jobs in less time for a lower cost. A contractor's proficiency can be good justification to a superintendent to use their services, allowing golf course personnel to spend their scheduled working hours accomplishing assigned duties and not be forced to catch up by working overtime.

Some superintendents can also reduce capital outlay for equipment by using a contractor to complete non-routine tasks. For example, superintendents in most areas of the country can hire a contractor to cultivate their greens with a specialized deep-tine or water-injection aerifier, thereby eliminating the need to add this expensive piece of equipment to their own inventory. In addition, courses benefit equipment-wise because contractors usually purchase the best, most efficient models and maintain them in good mechanical condition so that they can continue to earn a living. Saving on capital purchases by hiring a contractor assumes that the specialized equipment would not be useful on other areas of the course or during several different times of the growing season.

In northern regions contractors can help cope with temporary labor problems by completing tasks in the early spring or late fall. This can give superintendents the opportunity to forego the hiring of seasonal employees until early summer and/or rely on them less during the fall when they need to return to other activities. A good example would be a superintendent who hires a contractor to make large-scale weed control applications in the spring to free up full-time employees to prepare the course for summer. This would delay the need to hire seasonal employees for several weeks, or until the quality of the labor pool improves.

No matter how careful employees try to be, work-related injuries are always a possibility at the golf course. As is often the case for non-routine tasks, employees must operate specialized, unfamiliar equipment and/or handle foreign materials. By using an experienced contractor to complete certain non-routine tasks, the potential for injury can be decreased because their workers are familiar with the machinery and procedures. Along the same line, the number of training hours to acquaint golf course personnel with atypical tasks can be lessened.

At times, work completed under a service agreement can be a direct benefit to the golfers if the contractor has the equipment and manpower to get a job done fast. In the Chicagoland area, a growing number of superintendents are relying on contractors to make bulk fertilizer applications, as they have large spreaders that can cover an entire course ahead of morning play. Furthermore, because of the advanced technology of bulk application equipment, both the calibration and actual application are more precise.

Western settlers rarely made hired guns permanent houseguests because sooner or later they would attract trouble of their own. Similarly, there are several reasons for not becoming overly dependent on contract services.

In regions with unpredictable weather conditions, contractors who specialize in a particular maintenance operation can fall behind schedule. This is especially true when they are overbooked. For superintendents who cannot set aside alternate days in the play schedule for a contractor to complete the work before the agronomic window of opportunity closes, this can be a genuine hardship.

Using a contractor to make large-scale spray applications can help streamline a maintenance operation by reducing costs associated with special training, and storage and handling of special materials.

About a year ago, I visited a course that was closed on a Tuesday. They had flagged all of the irrigation heads to accommodate a contractor who had agreed to aerify and clean up all of the fairways in one working day. When the axle broke on the contractor's truck several miles out of town, it became clear that he was not going to be able to get the job done on time. It was nothing short of a nightmare for the new superintendent, who could not convince the owner to keep the course closed for another day. Having lost the only opportunity to aerify, the fairways had to wait until the next season.

Hiring a contractor can reduce equipment costs when a product application requires specialized machinery.

Over-reliance on contract services can also make it difficult for assistant superintendents and college interns to acquire skills that will be of value to them later in their careers. By eliminating too many learning opportunities for key personnel, a course's management can find it more difficult to attract highly motivated employees who seek challenging positions. In the long run, this may even affect daily course conditioning.

Another point to consider when evaluating the services of a contractor is the quality of their service. In short, there are contractors who are sincerely dedicated to providing the highest possible level of customer service, and there are those who fail to fully appreciate that the superintendent is ultimately responsible for their actions. If the task requires minute attention to detail and the golfers have very high expectations, it may be best for a superintendent to complete the job in-house rather than take the risk of letting an unskilled contractor drop the proverbial bomb in their lap. No matter what the circumstances, the

Table 1

A Green Section staff survey of contract services that generally are available in large metropolitan areas.

Aquatic management from A to Z.
Clubhouse landscape maintenance.
Course security.
Golf course construction services.
Deep-tine aerification of greens.
Large-scale fertilizer application.
Large-scale pest control application.
Large-scale weed control application.
Mower reel and bedknife sharpening.
Restroom cleaning and maintenance.
Specialized tree care.
Small animal and rodent control.
Traditional core aerification of fairways.
Tree pruning and removal.
Vertical mowing and core cultivation of fairways and rough.
Water injection aerification of greens.

In northern regions, using a contractor to complete non-routine tasks in the fall can help superintendents cope with the early departure of seasonal employees.


A contractor's experience and reputation should be taken into consideration when reviewing contract bids. Ultimately, the superintendent shoulders the responsibility for all maintenance activities performed on the golf course.

superintendent should always maintain decision-making powers over contractors and never allow them to work without close supervision.

Depending on the size of the metropolitan area, the range of readily available contract services can be quite extensive. In Table 1, a list of services compiled through a survey of the Green Section staff might leave one with the impression that all but the daily tasks of mowing and course setup can be hired out. Taken to the extreme, an owner or board of directors might even conclude that employing a well-trained, experienced superintendent would no longer be necessary, as only a skeleton crew would be required to take care of the course.

This extreme view is ridiculous. There are immediacy tasks, such as disease control applications, irrigation system repairs, etc., that cannot be hired out, since the time it would take for a contractor to receive a call and travel to the course might make the difference between success and failure. Furthermore, in the absence of an experienced superintendent, a course would become easy prey for unscrupulous contractors. Here I am reminded of the old adage "The only thing that happens fast in agriculture is crop failure."

In conclusion, bringing in the hired guns to streamline a maintenance operation has both advantages and disadvantages, depending on the circumstances at hand. Each course being different, superintendents must evaluate the cost of labor and equipment, the availability of staff, the contractor's proficiency with a given task, and the price for the service provided. And, since the responsibility for a contractor's actions rests heaviest on the shoulders of the superintendent, experience and reputation should be highly regarded while a watchful eye is always kept on their activities.

PAUL VERMEULEN *is the Director of the Green Section's Mid-Continent Region. He is responsible for the administration of Green Section programs in ten states and focuses his Turf Advisory Service visits in Arkansas, Illinois, Iowa, Kansas, Missouri, and Nebraska.*

Utilizing Preemergence Herbicides With and Without Fertilizer Carriers

Should you spray or should you use a granular carrier?

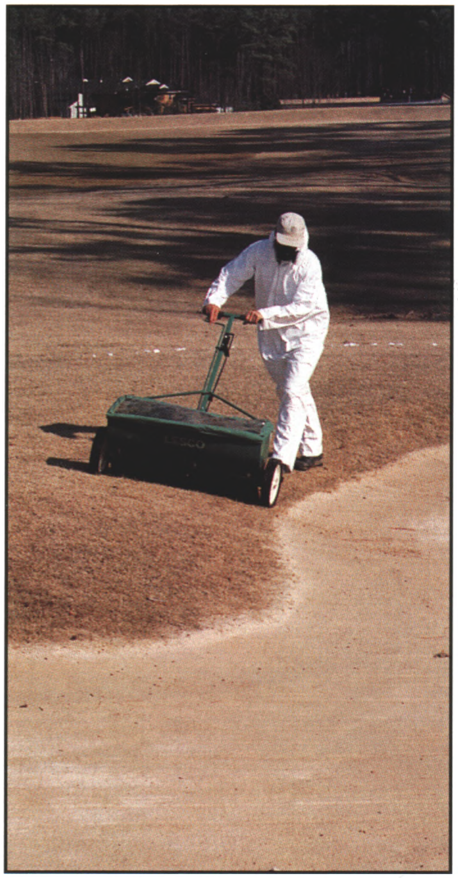
by FRED YELVERTON, Ph.D.

THE USE OF preemergence crabgrass/goosegrass herbicides as sprays versus impregnated or coated on a fertilizer carrier continues to be a much-debated topic among turfgrass managers and distributors of the products. Research on herbicide performance and an understanding of the behavior of the various preemergence herbicides in the environment indicate that each method of delivering preemergence herbicides has potential advantages and disadvantages. The purpose of the following discussion is to outline various factors that affect herbicide performance with the two types of application and to point out where one method may be favored over the other method.

To cover the pros and cons of using preemergence herbicides with and without fertilizer carriers, it is necessary to discuss this topic in three sections: 1) herbicide performance, 2) timing of application, and 3) environmental implications. The herbicides involved in this discussion are the major products utilized for crabgrass and goosegrass control: dithiopyr (Dimension), prodiamine (Barricade), oryzalin (Surflan), pendimethalin (various trade names), benefin + trifluralin (Team), and oxadiazon (Ronstar). These herbicides represent three herbicide families: 1) dinitroanilines or DNAs (Barricade, Surflan, Team, and pendimethalin), 2) pyridines (Dimension), and 3) oxadiazole (Ronstar).

Herbicide Performance

To compare and contrast herbicide performance when applying as sprays versus a dry carrier, it is important to have a clear understanding of how preemergence crabgrass/goosegrass herbicides work. The preemergence herbicides in question do not prevent seed germination; they kill the weed as it grows through the herbicide treated zone (1, 2). The DNAs and pyridines are absorbed by roots and shoots of germinating weeds and inhibit cell division in the growing points, and the weeds fail to emerge. Ronstar is absorbed in emerging shoots (not roots) and affects photosynthesis, and the emerging shoot dies (1). The fact that Ronstar is not absorbed by roots explains why it can be safely used when sprigging many warm-season turf species.



Drop spreaders and sprayers can be used in banding areas around impermeable surfaces and water resources to help reduce off-target movement of products.

Once a product is applied and watered in, a herbicide barrier is established in the soil/thatch layer. Therefore, uniform coverage with a preemergence herbicide, whether applied as a spray or granular, is necessary for optimum control. Large gaps in the herbicide-treated zone can result in weed escapes. Small gaps in this treated zone, such as those caused by aerification, generally do not adversely affect herbicide performance (5, 10).

When the herbicide application is on a granular carrier, once the treated turfgrass area is watered, the granule dissolves, and the herbicide barrier is established. Because the herbicides in question are readily adsorbed by soil organic matter, they do not move very far from the granule. Therefore, coverage with a granular product (whether coated on a fertilizer or on an inert dry carrier) must be uniform and dense enough to prevent large gaps in the herbicide barrier. When comparing coverage with a granular product versus a properly applied spray, coverage is usually better with a spray application. This does not necessarily mean control will be better with a spray.

From a coverage standpoint, a certain density of granules per unit area is necessary for adequate herbicide performance. On a granular carrier, particle size and uniformity of particle size are very important components of herbicide performance. As particle size decreases, the density of particles per unit area increases. This has been demonstrated by Kelly and Coates (9). In their research, southern crabgrass control increased to a point and then leveled off with decreasing particle size of the granular product. Uniformity of particle size is important because when spreading granular products, small and large particles can travel different distances from the application equipment.

The effects of coverage with various granular formulations on smooth crabgrass control is demonstrated in Table 1. In this experiment, Barricade applied as a 0.29G or as a spray provided better smooth crabgrass control than when applied as a 0.5G formulation. The most likely reason for these differences can be attributable to better coverage with the sprayable or 0.29G Barricade.

Bulk fertilizer and herbicide applications need to be carefully managed, especially on impervious surfaces. Some materials cannot bind to soil particles and are free to move with the water. Remove products from these areas before irrigation or rainfall. It's also very important to maintain a safe distance from wetland areas.

Table 1
Preemergence Smooth Crabgrass Control with Various Barricade Formulations
Yelverton and Hinton, 1996 (14)

Treatment	Rate (lbs ai/a)	% Control
Barricade 65WG	0.75	98
Barricade 0.29G	0.75	91
Barricade 0.5G	0.75	81
LSD ∝ 0.05		9.3

Hidden Valley Golf Club, Angier, NC. Applications made March 4 and final evaluations made September 26, 1996.

When bulk spreading granular products using large equipment, there are some areas on the golf course that are hard to reach, and coverage can sometimes be difficult. An example is a severe slope on the back of a tee. Control in these areas is sometimes less than in fairways due to difficulty in obtaining good coverage. In these areas, it is a good idea to make applications with smaller granular applicators, or to utilize sprays.

Coverage is only one aspect of obtaining adequate control with preemergence herbicides. Volatilization losses from herbicides also can impact herbicide performance. Herbicide volatility (as measured by vapor pressure) is a measure of the intramolecular bonding forces of a chemical, and it is an indicator of how easily a chemical (in this case a herbicide) changes from a liquid to a gas. Herbicide loss can occur due to volatility losses. In addition, preemergence crabgrass/goosegrass herbicides vary in their volatility. The relative volatilities of the various preemergence herbicides are listed in Table 2. Volatility losses also increase with increasing temperature. This is why pesticides have a stronger smell when temperatures are warm in the summer than in the winter.

Table 2
Vapor Pressure and Relative Volatility Ratings for Preemergence Crabgrass/Goosegrass Herbicides
(Measured as mm of HG @ 25° C)

Herbicide	Vapor Pressure	Relative Volatility Rating
benefin*	7.8×10^{-5}	Moderate
trifluralin*	1.1×10^{-4}	Moderate-High
Barricade	2.5×10^{-8}	Very Low
pendimethalin	9.4×10^{-6}	Low
Surflan	2.5×10^{-8}	Very Low
Dimension	4×10^{-6}	Low**
Ronstar	7.8×10^{-7}	Very Low

**Team is a combination of benefin and trifluralin*

***Dimension has low volatility, but one of the carriers in the EC formulation is volatile*

One way to help control volatility losses is by utilizing a herbicide on a granular carrier. When a spray application is made, the foliage intercepts some of the herbicide. The herbicide is subjected to volatilization losses and herbicide performance can sometimes be decreased. One way to help minimize volatility losses from spray applications is to water the herbicide in immediately after application. This will help remove the herbicide from the foliage and move it down in the canopy where the herbicide barrier is established. Higher wind speeds have also been shown to increase volatility losses (7). The effect of post-treatment irrigation was demonstrated by Gasper et al (8). They showed that pendimethalin efficacy on smooth crabgrass was reduced when irrigation was delayed later than the day of treatment. Volatility losses of pesticides have also been demonstrated by Cooper et al (7).

An example of how volatility may be important is demonstrated in Table 3.

While Dimension is not volatile, one of the carriers in the emulsifiable concentrate formulation is suspected of being volatile. In this case, the herbicides were not watered immediately after treatment. Rainfall was relied upon for herbicide activation. This delay in activation resulted in the lower rate of Dimension providing as good or better crabgrass control than the sprayable (EC) formulation.

Table 3
Preemergence Smooth Crabgrass Control with Dimension Formulations
Yelverton, Lewis, and Hinton, 1995 (13)

Treatment	Rate (lbs ai/a)	% Control
Dimension 1EC	0.5	90
Dimension 0.25G	0.38	98
LSD ∝ 0.05		NS

Thorndale Golf Club, 1995. Herbicides applied March 16 and final evaluations were September 19, 1995.

Photodegradation, or degradation by UV light, and dislodgeable foliar residues also may play a role in herbicide performance. When a herbicide application is made, sunlight may start to degrade the herbicide. If a product remains on the folaige for extended periods of time, degradation by sunlight may occur. Again, irrigation soon after a spray application can help minimize any of these potential losses. Following pesticide applications, especially when applying liquid materials, there remains some residue of that pesticide on the turfgrass foliage. Research has shown that some pesticides applied without irrigation had foliar residue levels four times higher than for irrigated turf (7). These residues of pesticides are known as dislodgeable residues.

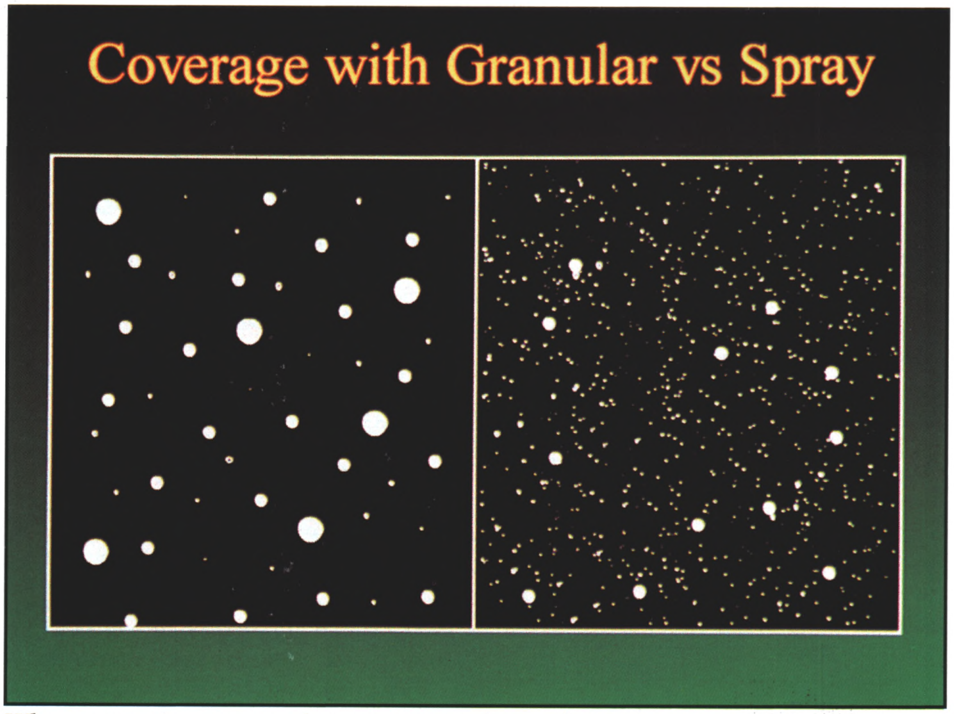
To summarize herbicide performance, maximum control with a granular product is dependent on achieving a minimum density of particles per unit area. Particle size and uniformity of size are important considerations when considering a granular product. Coverage is usually better with a properly applied spray application. Most spray applications need to be watered in soon after application to prevent volatility and other losses. By impregnating or coating a herbicide on a granular carrier, volatility losses potentially can be minimized.

Timing of Application of Herbicides Applied on Fertilizer Carriers

When applying herbicides on a fertilizer carrier, consideration must be given to the timing of herbicide and fertilizer application. If it is the correct time to apply a preemergence crabgrass/goosegrass herbicide and the turfgrass needs fertilizing, then obviously applying a herbicide on a fertilizer carrier can be advantageous. However, many times the two applications are not compatible. An example is non-overseeded warm-season grasses in the southern United States. Large and smooth crabgrass can germinate when soil temperatures reach about 55 degrees near the soil surface (11). Preemergence crabgrass herbicides need to be applied in many areas of the southern U.S. in late February through March. At this time, warm-season grasses are still dormant and will not be actively growing for another 4 to 8 weeks. Depending on the soil texture, soil type, and type of fertilizer, this can lead to nutrient losses because the turf is not actively growing. However, in the case of warm-season turf overseeded with perennial ryegrass, the timing may be compatible because the cool-season turf may be in need of fertilization at this time.

Environmental Implications

As previously mentioned, if the timing of a herbicide/fertilizer application occurs when the turf is not actively growing, the possibility exists of nutrient leaching through the soil profile. The extent of nutrient loss depends on soil texture, soil type, type and amount of fertilizer applied, and how well established the turf is. Brown et al (6) showed various levels of nitrogen leaching losses through a "Tifdwarf" bermudagrass putting green when fertilized with either ammonium nitrate in mid-February or ureaformaldehyde in late January. These researchers concluded that decreasing fertilizer rates during periods of slow growth could reduce nitrogen leaching losses. Bowman and Cherney (4) showed that nitrogen leaching losses were greatest on warm-season turf species soon after sodding, and leaching losses declined to very low levels once the turfgass became established. It is clear from both research projects that nitrogen leaching losses can be minimized by fertilizing warm-season turf species only when they are well-established and actively growing.



When comparing coverage between a granular product versus a properly applied spray, coverage is usually better with a spray application. This does not necessarily mean control will be better with a spray.

The preemergence herbicides discussed in this article are strongly adsorbed to soil colloids (primarily organic matter) and also have low water solubilities. As a result, they do not leach through the soil profile and are not subject to runoff unless the soil particle moves (12). However, when these products are inadvertently applied to asphalt, concrete, and other impermeable surfaces that may be found on the golf course, they are free to move with water. While certain nutrients such as nitrogen are more mobile than the herbicides in question, most research indicates little runoff occurs when products are properly applied to well-established turf. But as with herbicides, when they are applied to impermeable surfaces, they are free to move with water, and contamination of water resources may occur.

It is important that these materials (all pesticides and fertilizers) be applied only to established turfgrass areas. When applying granular materials, particularly when applied with large equipment, it is difficult to keep off these impermeable surfaces. If they inadvertently land on these surfaces, care should be taken to remove these products before irrigation or rainfall. To prevent placement on these surfaces, banding with drop spreaders or making a pass with a sprayer (10-15 foot band) next to concrete, asphalt, or ponds, lakes, etc., can be helpful. This will allow the larger bulk spreading equipment to stay further away from these areas and lessen the likelihood of off-target movement of pesticides and nutrients. Another helpful tool is to utilize buffer areas around ponds, lakes, and streams. Baird et al (3) demonstrated the buffer areas can reduce surface runoff losses of certain pesticides and phosphate-phosphorus from bermudagrass turf.

In summary, there are advantages to applying herbicides either as sprays or on granular carriers. Performance of the herbicide is dependent on the quality of the granular carrier and application. While better coverage is usually obtained with sprays, proper spray application is also important for optimum performance. Volatility losses from pesticides can be reduced by utilizing a granular carrier or by irrigating very soon after a spray application. This is more important for certain herbicides than others. Some herbicides have such low volatility, immediate irrigation is not necessary. Utilizing drop spreaders or spray applications to band around impermeable surfaces and water resources can help reduce off-target movement of pesticides and fertilizers on the golf course. There is increasing evidence that buffer areas around water can also help reduce potential soil runoff of pesticides and nutrients.

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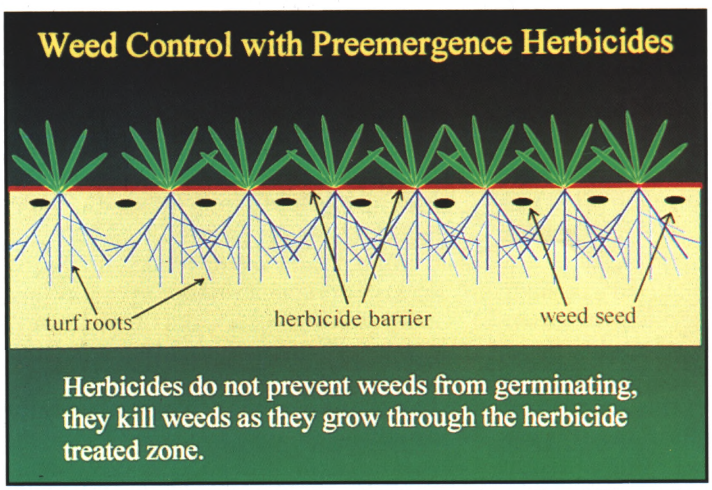
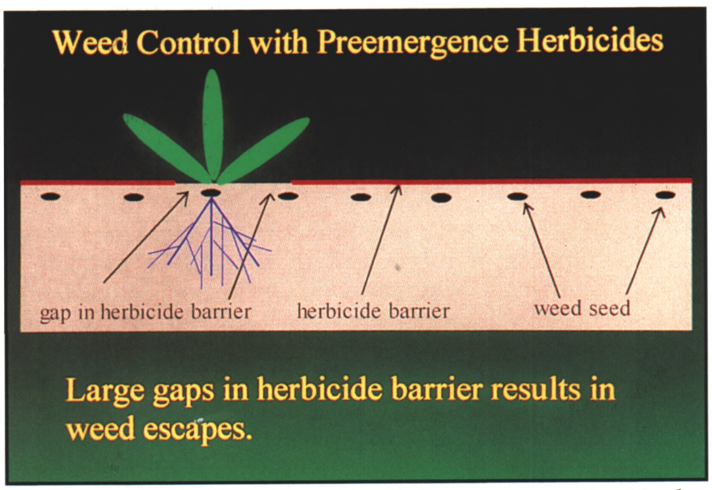
FRED YELVERTON, Ph.D., *is Assistant Professor of Crop Science at North Carolina State University. He conducts research and extension programs in turfgrass weed management and plant growth regulators.*





Preemergent herbicides create a barrier in the soil to kill weeds as they grow through the barrier zone. Uniform coverage is critical for optimum control.

A USGA-SPONSORED RESEARCH PROJECT

Seashore Paspalum Herbicide Management

Careful selection strategies are essential.

by R. R. DUNCAN, Ph.D.

Paspalum vaginatum Swartz (seashore paspalum, saltwater couch) is a warm-season, prostrate-growing, perennial turfgrass that is normally found between 30° and 35° N-S latitudes near sea level. The grass spreads by stolons and rhizomes and ranges in leaf texture from fine types (similar to Tifdwarf bermuda) for greens to coarse types (similar to St. Augustinegrass) for roughs. The species is adapted to marshy, brackish conditions, salty/saline soils, and waterlogging-prone areas.

MSMA (foreground) and Asulox (background) are phytotoxic to seashore paspalum. (Studies by Joe DeFrank on Quality Turf site, Waimanalo, Hawaii.)

Attributes

Ecotypes have been identified that tolerate ⅛-inch (3 mm) mowing height on greens and higher heights on tees and fairways. Coarse types can be maintained at up to 2 inches (50 mm) or 3 inches (75 mm) as a transition into wetlands, water hazards, or other environmentally sensitive areas. Paspalum has been used for bioremediation of polluted or contaminated soils and water.

Paspalum is one of the most salt-tolerant turfgrasses; ocean water or any type of reclaimed/recycled water can be used for irrigation. This grass tolerates and thrives in waterlogged or boggy low areas; yet some ecotypes have drought tolerance equal to centipedegrass when properly managed.

Paspalum can root equally well into heavy clay soils, sands, mucks, or loams. The grass has a pH adaptability range from 4.0 to 9.8. Nitrogen fertility rates should not exceed 5 lb per 1,000 sq. ft. per year after establishment and grow-in. If ocean water is used for irrigation, rates half that amount are adequate to maintain high turf quality.

Weed Control

Judicious rates and timely herbicide application strategies are essential for environmentally sound management of paspalum for turf from initial establishment/grow-in to long-term mainte-

Paspalum encroachment (dark green) into bermudagrass can be a potential problem on the golf course.

MSMA damage causes paspalum to turn dark brown, while Tifgreen bermudagrass damage is expressed by turning white.

nance. Preemergent and postemergent herbicides that are noninjurious to paspalum turf are shown in Table 1. Several herbicides that are normally used on other warm-season turf grasses (Surflan, Asulox, Aatrex, Sencor, and Princep) are phytotoxic to paspalum (Table 2).

Crabgrass, goosegrass, and annual bluegrass (*Poa annua*) in paspalum can be controlled with preemergence applications of Ronstar, Kerb, Balan, Pre M (many herbicides may have more than one trade name or similar/slightly different chemical formulations), Barricade, Team, Dimension, or Prograss (Table 3) or postemergent applications of Drive, Kerb, or Dimension. Winter broadleaf weeds can be controlled with Ronstar, Balan, and Gallery (preemergence) or Vanquish (postemergence) in paspalum turf. Nutsedge species can be controlled with postemergence applications of Manage or Basagran (Table 3).

When bermudagrass encroachment into paspalum turf is a problem, preliminary research results indicate that postemergence applications of Prograss + Cutlass (1× rate = 1.5 + 0.75 lb ai/A) may suppress the bermudagrass. Best preliminary results have occurred with applications during spring green-up when temperatures are conducive to active warm-season grass growth. If temperatures are less favorable (< 70° F) for continued bermudagrass and paspalum growth during the spring, Prograss + Cutlass will injure the paspalum. Rates of this herbicide + growth regulator combination as high as 2×-3× may be needed to control bermudagrass encroachment during the summer months, with 2-4 sequential applications.

When paspalum encroachment into bermuda is a problem, preliminary research has shown that Trimec Plus, Trimec Classic, Daconate 6, and Asulox will suppress paspalum growth (Table 2). Multiple applications will probably be needed and more than one type of herbicide in sequence should be considered in the paspalum control strategy. Primo and Acclaim could be included with the above four herbicides to provide a growth regulation effect on paspalum and enhance the herbicidal activity and effectiveness.

Additional research is ongoing at the University of Georgia at Griffin concerning herbicide efficacy, timing, rates, and environmental interactions on paspalum used for turf on greens, tees, and fairways.

Acknowledgments

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DR. RONNY DUNCAN *is professor of turfgrass science at the University of Georgia in Griffin, Georgia. He's traveled the world's seashores looking for seashore paspalum selections.*

Table 1
Herbicides Non-Injurious to Paspalum Turf

Preemergence Applications

- *Betasan EC
- Kerb WP
- Balan G
- Dacthal WP
- Ronstar G
- Pre-M WDG

(Marginal: Goal EC and XL 2G)

Postemergence Applications

- Prograss EC
- Drive DF/WD
- *Trimec Southern SL
- Dimension EC
- *Super Trimec SL
- *Vanquish SL
- Manage WG
- *Mecomec 4SL

(Marginal: Amine 4SL)

**These herbicides have more than one trade name or similar/slightly different chemical formulations*

Table 2
Herbicides Phytotoxic to Paspalum Turf

Preemergence Applications

- Ronstar WP
- Surflan AS

Postemergence Applications

- Asulox SL
- *Aatrex WP
- *Sencor DF
- *Daconate 6 SL
- Vantage EC
- *Princep WP
- Image SL
- *Bueno 6 SL
- *Trimec Plus SL
- *Trimec Classic SL
- Turflon ester EC
- Confront SL
- Acclaim EC

**These herbicides have more than one trade name or similar/slightly different chemical formulations*

Table 3
Specific Weed Control Options for Herbicide Use on Paspalum

Herbicide	Chemical Family	Weeds Controlled
Preemergence		
Ronstar G	oxadiazol	Crabgrass, goosegrass, annual bluegrass, winter broadleaf weeds
Kerb WP	amide	Annual bluegrass
Balan	dinitroaniline	Annual bluegrass, winter weeds, crabgrass (short season control)
Pre-M WDG*	dinitroaniline	Crabgrass, goosegrass, annual bluegrass
Barricade WDG	dinitroaniline	Crabgrass, goosegrass, annual bluegrass
Team G	dinitroaniline	Crabgrass, annual bluegrass
Dimension	pyridine	Crabgrass, goosegrass, annual bluegrass
Prograss EC		Annual bluegrass
Gallery WG	benzamide	Annual broadleaf weeds
Postemergence		
Kerb WP	amide	Annual bluegrass
Dimension EC	pyridine	Crabgrass (early)
Drive		Crabgrass
Prograss EC		Bermuda (in combination with Cutlass)
Vanquish SL	benzoic acid	Broadleaf weeds
Manage WG	sulfonylurea	Purple/yellow nutsedge
Basagran T/O	benzothiadiazole	Yellow nutsedge

**This herbicide has more than one trade name or similar/slightly different chemical formulations*

Going Native on the Course

A planning and planting experience.

by LUKE CELLA

NATIVE PLANTS and plantings have a real place in the world of golf. Finding the place, planting and caring for the areas are up to us. One may ask, "Why even try to restore a site to its native vegetation?" The answer is simple: There is an aesthetic appeal that becomes quickly evident, and in the long term we are preserving many rare plants, animals, and natural communities.

The key to planting a successful native or natural area is to plan it properly. Look carefully at the area you wish to restore to its native vegetation. When I first started working with Audubon International for the certification of the Pottawatomie Golf Course in St. Charles, Illinois, I drew a plan noting all of the available space for native restoration plantings on the golf course property. The next logical step was to choose a site for my first restoration. The questions that needed to be answered were: Is the area out of play but not out of sight? What type of soil does the site possess? How much sun reaches the location? How will the plantings work into the existing landscape? What kind of preparation does the site need?

I asked the advice of a friend and teacher to help me make the site selection. He told me to keep it small for my first attempt at this type of project. The area I chose to restore measured close to 6,000 square feet along the Fox River. It had its own natural boundaries — the river, a cart path, and the rough from the third hole. The location would serve as a backdrop for an approach shot to our third green and was highly noticeable as golfers made their way to the third green.

The next step was to take a close look at the area's soil and sun conditions. It turned out that part of the area flooded occasionally with the changing seasons. After a heavy rain I marked off the line that water had reached and staked this area off. I could also see that other parts of the site would rarely flood and marked these areas. The areas in the middle would serve as a transition between the two. The reason for this delineation becomes important in plant selection. The area also received full sun after I removed a small cottonwood tree that had sprouted up and transplanted a willow that had been planted in the area a few years earlier.

A local boy scout troop was interested in helping with the restoration of the native area. Prior to planting, the area was prepared by killing all the existing vegetation and burning off the excess organic matter. The area to be planted was marked with different paint colors that corresponded to the appropriate plant flats.

When planting a prairie or native vegetation, plants are grouped not only by zones but also by the amount of moisture in the soil.

- *Wet* is soggy or marshy most of the year.
- *Wet-Mesic* is excessively wet in winter, spring, and after heavy rains, but dries in summer.
- *Mesic* is of average moistness, water readily soaks in with little runoff, and is considered average garden soil.
- *Dry-Mesic* is well-drained soil, and water is drained from the soil readily, but not rapidly.
- *Dry* is excessively drained.

Sun requirements are defined as follows:

- *Prairie:* Plants grow normally in full sun. Should do well with a half day or more of sun.
- *Savanna:* Partially shaded. Sun will reach ground level through the openings between trees.
- *Woodland:* Heavily shaded by a closed canopy of trees.

After we defined the soil type and the sunlight the site possessed, we then began to choose plant species. The plan was to use plugs of native plant material on the outside edges of the whole area, about 12 feet deep towards the middle. The middle portion of the selected site would be seeded. I wanted to plug for a couple of reasons. First of all, this area could be irrigated, and I wanted to establish the plants quickly and provide some diversity right away, not only with color, but texture and height as well. Selecting the plant material was new to me. I started by contacting

Audubon International for suppliers of native plant material in my area. They sent me a list of all the available seed and plant producers close to my location. Next I contacted these suppliers and requested catalogues. Soon the catalogues showed up in the mail and I looked through them for plant material and seed possibilities. Feeling baffled by the amount and types of material to choose from, I contacted individual suppliers and found that most of them are more than willing to answer questions about planning native areas.

The next step was to prepare the site for planting. I used a non-selective herbicide to kill all of the existing vegetation. In this case, the area was primarily annual ryegrass and bluegrass. I waited to see the effects of the application and then went back and retreated areas that needed it. After all of the existing vegetation was dead, I contacted the fire department and received a land management burn permit. One evening before the dew set in, I burned the decaying vegetation and the weed seeds that had found their way into the site. The site was now ready to plant. All of the existing vegetation was gone and the soil was undisturbed. The less the soil is disturbed, the less likely weed seeds will germinate in the area.

Planting time approached, and I asked the local boy scout troop to help out with the planting. I had the plugs delivered the day prior to the scheduled planting day. The plug trays are a little different from most because of the depth of the actual plug. The diameter is close to two inches, but the depth of the plugs is five inches to accommodate some of the plants' taproots. I carefully laid out all of the areas in the site with string and had a staff member operate a drill with an auger bit attached to make the holes for the scout troop. This method proved least disruptive to the soil around the plugs. I marked the flats with colors that coincided with the areas that went with that type of plant. I let the troop choose where to plant individual plants as long as they were within the right soil type boundary. We did make sure the tall plants were planted close to the middle of the site, with the shorter and more colorful plants closer to the edge where traffic passed steadily. When the troop finished, the plugs were thoroughly watered. I then applied a preemergent herbicide between the plugs and watered it into the soil. The middle of the site was seeded by lightly scraping the soil, sowing the seeds, and hand raking. Because the area previously had received foot traffic, I put up a temporary fence to train the golfers to walk around the area instead of through it as they normally had.

The plugs were watered by sprinklers for about a month to establish their root systems. The watering also helped the native seed in the middle to germinate a little more quickly than normal. One problem with irrigating the area was that it had forced some weed seeds to germinate as well. Because the area was relatively small, I was able to have some of my staff hand weed among the native plants when the course was crowded during league play. Most seeded sites can be mowed a couple of times a year when the plants reach a height of 12 inches. It is recommended to cut the plants to a height of six inches. Mowing is detrimental to the annual weeds and prevents them from producing seed. The native plants are usually too small to be injured by a six-inch mowing during their first year.

I plan to burn the area early next spring. All of the plants that established themselves this past season have now stored a large portion of their nutrients in their underground system of roots and will survive their first burn. The burning will help warm the soil by exposing the blackened ground to the spring sun. Over time I would like to find new places on the golf course and repeat the process of restoring sites with native vegetation. Despite the investment of time and materials, we need to remember that these native areas are sustainable. They can survive on their own and maintain the natural diversity found in our environment.

(Left) The area was irrigated for about a month to help the plugs take root and to help the seeds germinate. Temporary fencing was used on the outside edge of the area to help train golfers to walk around the area rather than through it. (Right) Now the native plants have taken hold in their new home. The project has been well worth the investment of time and energy.

LUKE CELLA *is the superintendent at the 58-year-old, Robert Trent Jones-designed Pottawatomie Golf Course in St. Charles, Illinois. In October of 1997, Pottawatomie Golf Course became the first fully certified Audubon Cooperative Sanctuary System nine-hole facility in the program.*

NEWS NOTES

Research Update

The USGA Turfgrass and Environmental Research Committee at work at its December 1997 meeting in San Antonio, Texas.

THE USGA's Turfgrass and Environmental Research Committee met during the first week of December 1997 to evaluate more than 70 proposals from university researchers for various turfgrass-related projects for the period 1998-2002. At stake was approximately $1.4 million of the $2 million annual funding approved by the USGA Executive Committee in August of 1996. After two days of intensive evaluations and discussions, the Committee approved funding for 41 projects at an annual cost of about $950,000. Other projects will be considered at the Committee's meeting in May 1998. This funding total does not include the $200,000 allocated to fund the Wildlife Links Program, which earmarks funds for wildlife-related research, or the funding of the five-year green construction investigations that began in 1996.

The following table indicates the anticipated funding of turfgrass and environmental programs, by category, for 1998.

1998 Grant Estimates

Project Area			*1998 Est.*
Cooperative Sanctuary			$ 100,000
Wildlife Links			200,000
Germplasm Enhancement			424,417
Integrated Turfgrass Management			292,409
Risk Assessment			0
Site-Specific Management			0
Sustainable Land Use			10,000
Pesticide/Nutrient Fate			181,540
Course Construction	Current	120,000	
	Proposed	48,600	
	Subtotal		168,600
Putting Green Test	Current	105,000	
	Data Collection	14,000	
	Subtotal		119,000
Contingency*			200,000
	Total		**$1,695,966**

**Includes projects that may be funded at the May 1998 meeting, as well as potential studies concerning soil testing*

Say 'So Long' to the Western Region

THE growing number of clubs participating in the Green Section's Turf Advisory Service in the western United States has precipitated a few changes in the Green Section's regional structure.

Effective immediately, the Western Region exists no more! It has been divided into two regions: the Northwest Region, encompassing the states of Alaska, Washington, Oregon, Idaho, Wyoming, and Hawaii; and the Southwest Region, consisting of California, Arizona, Nevada, Utah, and Colorado.

Pat Gross (pictured above), who has been an agronomist for the Western Region since 1992, has been promoted to the position of director of the newly formed Southwest Region. He will oversee the Green Section's Turf Advisory Service and other regional activities along with Mike Huck, an agronomist who joined the Western Region staff in 1995. Pat brings outstanding experience to his new position. He is a California State Polytechnic University graduate who majored in ornamental horticulture with a specialization in turfgrass science. His hands-on golf experience includes work at Industry Hills Golf Course, Industry, California; Shandin Hills Golf Course, San Bernardino, California; and Hacienda Golf Club, La Habra Heights, California.

Larry Gilhuly, previously director of the Western Region, now serves as director of the newly created Northwest Region.

Committee Volunteers

Tom Burton (left) and Dr. Vic Gibeault.

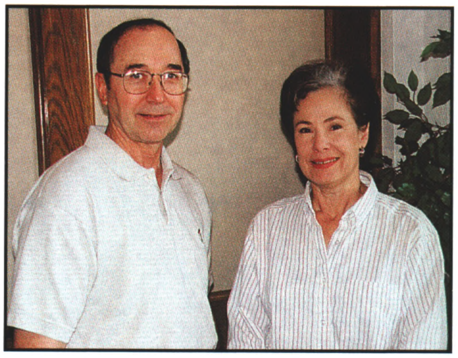
THE MAINSTAY of the USGA is the willingness of people across all walks of the golf industry to volunteer their time and talents to the many USGA Committees. Tom Burton and Dr. Vic Gibeault are two such individuals who have generously given to the USGA.

Tom Burton, Sea Island Golf Club, Sea Island, Georgia, recently stepped down from the USGA Turfgrass and Environmental Research Committee. From 1988 to 1997, Tom used his talents and experience as a golf course superintendent to help focus research project objectives on the needs of superintendents. Dr. Vic Gibeault, University of California — Riverside, who joined the USGA Research Committee in 1985, also is retiring from the Committee. He is redirecting his efforts on new turf research projects at Riverside, specifically in the area of turfgrass sustainability. He also is acting as vice chair in the Botany and Plant Science Department, reviewing the role of California extension specialists.

Both men have seen the turfgrass research program take great strides in the development of improved turfgrasses that substantially reduce water use, pesticide use, and maintenance costs. They helped oversee the expansion of the program from an emphasis on turfgrass breeding to include new research to develop management practices that protect the environment while providing high quality playing surfaces. The Turfgrass and Environmental Research Committee also oversaw the grants that allowed the development of the Audubon Cooperative Sanctuary Program for Golf Courses and more recently the launching of new research through the Wildlife Links Program, pertaining to wildlife on golf courses.

The USGA thanks both Tom and Vic for their dedicated service to the USGA for the betterment of the game of golf.

Welcome New Committee Members



THE Green Section is pleased to announce that Dr. Gerald Pepin and Dr. Patricia Cobb have agreed to lend their talents to the USGA Turfgrass and Environmental Research Committee. Dr. Pepin is the executive vice-president and general manager of Pickseed West, Inc., based in Jefferson, Oregon. Dr. Cobb is a professor in extension entomology at Auburn University, Auburn, Alabama.

As visiting scientists, they will serve a two-year appointment to the committee, through 1999. Drs. Pepin and Cobb will attend research committee meetings, review research proposals, and participate in monitoring visits to USGA-sponsored research sites throughout the year.

Attention Effluent/Reclaimed/Recycled Irrigation Water Users: We Need Your Help!

THE *WateReuse* Association, an organization dedicated to increasing water recycling, recently formed a golf course work group. This organization is comprised of a broad spectrum of members from public agencies, consultants, and private industry, along with regulatory agencies working together to find solutions to recycled water use problems. The association was organized in 1990 to address recycled water use in the state of California. Their scope has now expanded to include national and international concerns.

The golf course work group was formed under the Landscape/Horticulture Subcommittee of the Agriculture Committee. Mike Huck, agronomist, USGA Green Section Southwestern Region, is heading this group in conjunction with committee members Pat Gross, Director, USGA Southwestern Region, and Mark Stanek, Technical Advisor / Water Quality, City of Sunnyvale, California, Department of Public Works. The work group intends to address specific problems and concerns that golf courses have with recycled irrigation water, including:

- Developing an accurate and up-to-date database of golf courses irrigating with recycled water.
- Survey golf courses using recycled water to identify specific problems and gain feedback from users.
- Suggest minimum water quality standards for turf (and particularly putting greens) irrigation with regard to salinity, pH, SAR, bicarbonate content, and toxic ions.
- Develop design and management guidelines for lakes to reduce the need for algae and water weed control by using the input and experience of water reclamation engineers and treatment plant operators.
- Recommend that recycled water suppliers provide golf course users with water analysis reports on a frequent basis that address water quality from both agricultural suitability and human health standpoints.
- Establish uniform system retrofit standards with regard to backflow, signage, cross connection, health and safety regulations, etc.
- Develop best management practices.

If your course currently uses or is scheduled to begin using recycled water in the near future, we need your help to develop a database of users. Please send the name, address, phone, and fax of your golf course, and a contact person to:

Mike Huck
USGA Southwest Region
505 N. Tustin Ave., Suite 121
Santa Ana, CA 92705
Fax (714) 542-5777
e-mail: mhuck@usga.org

This will assure that our upcoming user survey reaches you, and your experiences with recycled water are documented. Thank you for your participation.

Physical Soil Testing Laboratories*

The following laboratories are accredited by the American Association for Laboratory Accreditation (A2LA), having demonstrated ongoing competency in testing materials specified in the USGA's Recommendations for Putting Green Construction. The USGA recommends that only A2LA-accredited laboratories be used for testing and analyzing materials for building greens according to our guidelines.

BROOKSIDE LABORATORIES, INC.
308 S. Main Street
New Knoxville, OH 45871
Attn: Mark Flock
(419) 753-2448
(419) 753-2949 FAX

EUROPEAN TURFGRASS LABORATORIES LIMITED
3 Cunningham Road
Springkerse Industrial East
Stirling FK7 7SL Scotland
Attn: John Souter
(44) 1786-449195
(44) 1786-449688 FAX

N. W. HUMMEL & CO.
35 King Street, P.O. Box 606
Trumansburg, NY 14886
Attn: Norm Hummel
(607) 387-5694
(607) 387-9499 FAX

THOMAS TURF SERVICES, INC.
1501 FM 2818, Suite 302
College Station, TX 77840-5247
Attn: Bob Yzaguirre / Jim Thomas
(409) 764-2050
(409) 764-2152 FAX

TIFTON PHYSICAL SOIL TESTING LABORATORY, INC.
1412 Murray Avenue
Tifton, GA 31794
Attn: Powell Gaines
(912) 382-7292
(912) 382-7992 FAX

TURF DIAGNOSTICS AND DESIGN, INC.
310-A North Winchester Street
Olathe, KS 66062
Attn: Chuck Dixon
(913) 780-6725
(913) 780-6759 FAX

*Revised January 1998. Please contact the USGA Green Section (908-234-2300) for an updated list of accredited laboratories.

CORE CULTIVATION: Too Much of a Good Thing?

It's time to re-think a time-honored cultural practice.

by JAMES E. SKORULSKI

SOME ISSUES are probably better left for after-hours round-table discussions in places where the music is a little loud and cigar smoke fills the air. The topic of coring greens may be one of those, but I will take a chance in hopes that this opinion will cause a few to reevalute their programs or at least stimulate some healthy debate.

I will start by saying that the benefits of conventional core cultivation cannot be denied. Core cultivation is used to alleviate the negative impact of surface compaction, modify poor quality soils, reduce the effects of layering, manage thatch, help overcome the effects of poor quality water, and overseed existing turf. It will continue to be an integral practice at golf courses around the world for those reasons. There are, however, negative aspects associated with core cultivation, the most obvious being the disruption it causes to the playing surface. How often have you heard, "Just when the greens get good you go tearing them up"? I have little sympathy for the golfer in most instances, knowing the benefits of core aerification. However, life would be a little bit easier if we did not have to do battle over this issue each and every summer. Another question to ask is, Does repeated core cultivation create an opportunity for annual bluegrass to invade? The answer is yes, it probably does, especially if the operation is completed at times when the turf is slow to recover. This may be of little concern if *Poa annua* is already your predominant grass species, but it is a point worth considering at new golf courses. There are other reasons why traditional core cultivation is not a popular topic in maintenance facilities around the world, but it is generally accepted that the program is a necessity whose benefits far outweigh the drawbacks.

This is probably the case at most golf courses. But — and be careful here — what if you could reduce traditional core cultivation without jeopardizing the turf and, more importantly, your job? Would you do it? To answer this question, first review the aerification programs in place to determine their effectiveness, and decide whether they remain consistent with your agronomic objectives. For example, when core cultivation is used to modify native-soil, push-up style greens, it is the most effective tool for this purpose. However, what is the role of core aerification after the upper 4 inches of the soil profile has been completely modified with a sandy material? Is surface compaction still a major concern even after the soils are modified? Hopefully not, but there are other less disruptive aerification tools available for alleviating surface compaction alone. Does core cultivation then become a thatch management and overseeding tool and, if so, can the operation be completed less frequently, with smaller tines, or replaced or supplemented with deep verticutting or some other type of cultivation?

Another consideration involves coring sand-based bentgrass greens. Assume that the greens are properly built with a sand meeting the guidelines developed by the USGA for putting green construction. The primary reason for core cultivation on such greens should be to manage the organic matter that accumulates in the upper profile. However, there are other cultivation tools that may manage the organic material equally well. Have you investigated or experimented with the use of smaller 0.25-inch hollow quadra-tines, more aggressive vertical mowing or slicing programs? Do you have the ability to topdress as needed throughout the season to minimize thatch buildup and prevent layering? Can the fertility programs be modified to meet the growing needs of the turf without stimulating unnecessary growth? Is it practical to manipulate pH to encourage the decomposition of organic material that already exists? The answers to these questions can only be determined through extensive field evaluation, laboratory testing, and knowledge of the greens' performance and the resources that are available. Core cultivation will likely continue to be an important tool for managing the organic matter and layering problems in sand-based systems. But if we begin utilizing other available cultivation tools and fine-tuning our cultural practices, then perhaps the frequency or aggressiveness of coring can be reduced, minimizing *Poa annua* encroachment and the surface disruption so despised by golfers.

I am not advocating, nor do I ever anticipate, the complete elimination of core cultivation from golf course operations. Even reducing the frequency of core cultivation may not be possible at many golf courses where soil quality is marginal, traffic heavy, the greens small, or the water quality poor. As the golf course superintendent, only you should make the ultimate decisions regarding what, when, and how cultivation programs are carried out. However, re-evaluate the goals of your current core cultivation programs and the new tools that are available with an open mind, and begin asking yourself, "What if . . . ?" You just might surprise yourself.

JAMES E. SKORULSKI *is an agronomist in the Green Section's Northeastern Region.*

THE USGA

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Turfgrass Information File (TGIF):
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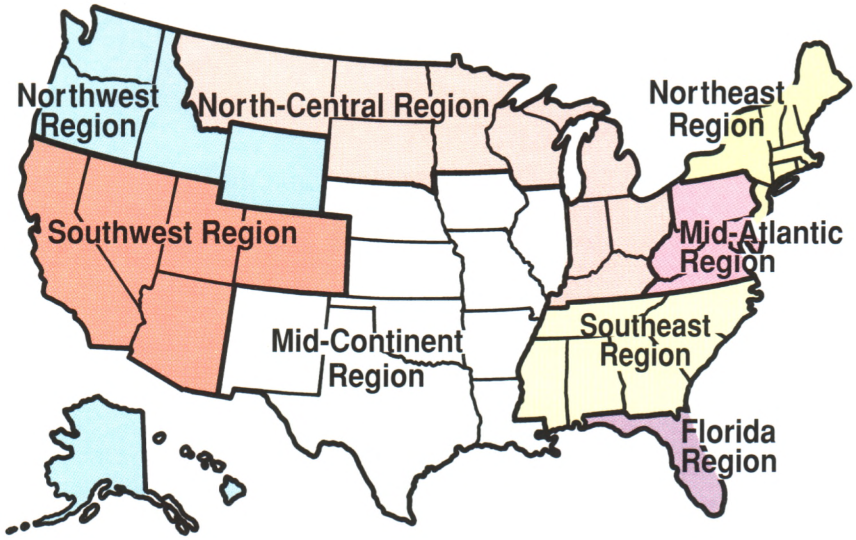
(517) 353-7209



GREEN SECTION NATIONAL OFFICES:
United States Golf Association, Golf House
P.O. Box 708, Far Hills, NJ 07931 • (908) 234-2300 • Fax (908) 781-1736
James T. Snow, *National Director*
Kimberly S. Erusha, Ph.D., *Director of Education*

Research:
P.O. Box 2227, Stillwater, OK 74076 • (405) 743-3900 • Fax (405) 743-3910
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REGIONAL OFFICES:

Northeast Region:
P.O. Box 4717, Easton, PA 18043 • (610) 515-1660 • Fax (610) 515-1663
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Stanley J. Zontek, *Director* • Keith A. Happ, *Agronomist* • Darin S. Bevard, *Agronomist*

Southeast Region:
P.O. Box 95, Griffin, GA 30224-0095 • (770) 229-8125 • Fax (770) 229-5974
Patrick M. O'Brien, *Director*
4770 Sandpiper Lane, Birmingham, AL 35244 • (205) 444-5079 • Fax (205) 444-9561
Christopher E. Hartwiger, *Agronomist*

Florida Region:
P.O. Box 1087, Hobe Sound, FL 33475-1087 • (561) 546-2620 • Fax (561) 546-4653
John H. Foy, *Director*

Mid-Continent Region:
P.O. Box 1130, Mahomet, IL 61853 • (217) 586-2490 • Fax (217) 586-2169
Paul H. Vermeulen, *Director*
4232 Arbor Lane, Carrollton, TX 75010 • (972) 492-3663 • Fax (972) 492-1350
Brian M. Maloy, *Agronomist*

North-Central Region:
P.O. Box 15249, Covington, KY 41015-0249 • (606) 356-3272 • Fax (606) 356-1847
Robert A. Brame, *Director*
P.O. Box 5069, Elm Grove, WI 53122 • (414) 797-8743 • Fax (414) 797-8838
Robert C. Vavrek, Jr., *Agronomist*

Northwest Region:
5610 Old Stump Drive N.W., Gig Harbor, WA 98332
(253) 858-2266 • Fax (253) 857-6698
Larry W. Gilhuly, *Director*

Southwest Region:
505 North Tustin Avenue, Suite 121, Santa Ana, CA 92705
(714) 542-5766 • Fax (714) 542-5777
Patrick J. Gross, *Director* • Michael T. Huck, *Agronomist*

TURF TWISTERS

REGULAR CALIBRATION

Question: Earlier this winter, during the cool weather and heavy rains, I noticed some pink snow mold active on some of my greens. The greens were too wet to use our spray rig, so I chose to use a backpack sprayer. However, I had difficulty calibrating it for proper delivery. Is there an easy way to calibrate a backpack sprayer accurately? (Maryland)

Answer: Calibrating a backpack sprayer is not difficult if these steps are followed. First, determine your spray width and measure a path on a level surface to a set length. Determine the amount of time you need to walk your path. Do this with the sprayer on your back *at least* half full. Next, using plain water, collect the spray from the nozzle and determine the volume collected over the same time frame. Be sure to maintain your spraying pressure during this step. Once you know the area covered and volume delivered, a volume/unit area can be determined and fungicide added accordingly.

SCHEDULES

Question: As a recently appointed green committee chairman, I am finding it extremely difficult to integrate our maintenance schedule into our pre-established tournament calendar. Any suggestions? (Arizona)

Answer: Poor maintenance planning affects the entire membership and not just tournament participants. Many maintenance practices should be performed when growing conditions are optimal. If not, they can have a negative impact on course conditioning for many seasons to come. So, with this in mind, it is best to develop the maintenance schedule first and then integrate tournaments around these dates.

ASSIST MAINTENANCE OBJECTIVES

Question: What are the most popular types of TAS visits that are done by your agronomists? (Iowa)

Answer: Great question. Here are just a few examples of the types of visits requested by superintendents:

- Typical course tour with the superintendent and course officials.
- Presentations for special projects such as green reconstruction, fairway grassing, irrigation system upgrading, etc.
- One-on-one meetings with superintendents to discuss technical information.
- Assist with orientation of new Green Committee members.
- Speak at crew meetings to help reinforce maintenance expectations of the course.
- Assistance in developing long-range plans and maintenance objectives.