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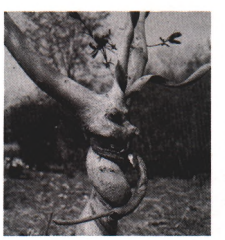

Cover Photo:
A neglected tree strangled by a vine.

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Mulching trees properly regulates soil moisture and soil temperature fluctuations and provides a pleasing appearance.

Modern Tree Management Techniques For Today's Turf Manager

by PATRICK M. O'BRIEN
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EARLY Scottish golfers didn't have to worry about trees affecting their golf score. The Linksland of Scotland had no trees. To many golfers in the United States, though, these Scottish courses look oddly barren. In the U.S., we enjoy the aesthetics and golfing challenge that trees contribute.

A good example of a challenging tree is the loblolly pine in the middle of the 17th fairway at Augusta National. This individual pine was a source of frustration to President Dwight Eisenhower. The Chairman of Augusta National at that time, Clifford Roberts, would not permit the removal of this tree, even at the request of our nation's President! Today this pine is respectfully named the "Eisenhower" tree.

Even though we enjoy the beauty and challenge of trees on our courses, tree management has not been emphasized in turf management training. The attitude that trees will live forever without any help from man has prevailed. Today, however, many trees are in a

declining or dying condition on golf courses due to a decade-long drought, increased air pollution, higher soil temperatures, severe winter freezes, and other factors. The golf course superintendent now faces the choice of cutting down trees as they die or obtaining more information on tree care.

As it turns out, neglect and abuse, rather than disease, are responsible for most golf course tree fatalities. It can be difficult or expensive to control diseases, but it is usually possible to control abuse and neglect and thus prolong the life of valuable trees. It is often easier and more economical to provide a sound tree management program than it is to continuously clean up storm damage, remove dead branches or trees, and then plant new trees.

To initiate a tree management program, the golf course superintendent needs an appreciation of the conditions under which trees grow best. In nature, a seed falls to the ground, germinates, and takes root. An average of five to seven primary roots are produced and grow outward from the trunk like spokes radiating from the hub of a wheel. The distance they grow varies with the soil and terrain, but is generally considered to be equal to one to two times the height of the tree. The depth to which roots grow varies with the depth, texture, and drainage of the soil. The feeder roots (those that absorb nutrients, water, and oxygen necessary for survival) are generally located in the top four to 12 inches of the soil, and most are in the top six inches. Because of their close proximity to the soil surface, these roots are very sensitive to such factors as heat, drought, flooding, herbicides, compaction, scraping, trenching, grass competition, and grass cultivation.

In a natural setting, feeder roots benefit from the thick, rich layer of organic litter (leaves, twigs, etc.) that usually develops. As leaves and twigs fall to the ground and decompose, they recycle nutrients, absorb and retain moisture, insulate the soil from environmental extremes, and protect delicate roots from the effects of compaction.

Man has altered this environment on most golf courses. During construction, bulldozers, backhoes, and other heavy machines are used to clean out underbrush and stumps, and to scrape away "undesirable" organic material. Grading, adding soil, root raking, discing, and other mechanical activities commonly follow as man prepares the soil for turf establishment. Lime is generally applied to raise the soil pH, and fertilizers high in nitrogen are added so that the grass will grow. Later, irrigation, high-nitrogen fertilizers, and certain herbicides stimulate vegetative growth, causing trees to develop thin cell walls. Such trees are often weak, and during drought, freeze, and ice conditions, these thin cell walls can crack or collapse. In addition, such trees frequently develop weeping limbs and branch breakage. It is a wonder that any trees at all survive the initial destruction of their roots as a result of construction and follow-up activities.

THE OTHER activity of man that can pave the way for the eventual demise of a tree is to create a wound in its protective bark layer. Spores of decay-causing fungi, which are always present in the air and in the soil but generally of little harm to a tree that is protected by its layer of bark, can then readily enter the tree and begin the decay process. Decay can compromise the ability of a tree to nourish itself, to survive environmental stresses, and to support itself or its wounded limbs. It can be said, in fact, that a wound is the beginning of the end of many trees.

On golf courses, it is not uncommon to see that two, three, or more of the five to seven major roots of an average tree have been severed, shattered, or wounded to the point that they have been destroyed or their functional ability has been greatly reduced. In many instances, this damage need not have occurred. Golf course superintendents can easily take precautions to protect the root systems of trees.

Following are six management practices for healthier golf course trees:

Mulching — The use of mulch conflicts with the current standards for playability on many areas of a golf course, but there are portions of many courses that could probably be mulched. Where this is possible, the ideal situation is to create a forest-like environment for tree roots. This involves replacing the turf with mulch, which research has shown will produce more feeder roots and healthier trees. In addition to the benefits of an organic mulch mentioned previously, mulches tend to reduce tree injuries from mowers, weed-eaters, and herbicides, and in some instances maintenance costs can be reduced.

One of the easiest and least expensive ways for most golf courses to initiate a mulching program is to collect and distribute shredded fallen leaves over out-of-play areas where turf is not doing well or where a natural setting is more appropriate. This type of mulch should be layered to a depth of three to four inches over the soil surface, and extend from the trunk outward as far as possible. In areas where pines are the predominant trees, pine needles should not be removed from the forest floor, but allowed to accumulate.

Because of its availability, pine straw is the most widely selected mulch in the Southeast. Unfortunately, pine straw has very limited ability to reduce evaporation from the soil or to protect the soil from the heating and drying effects of the sun unless it is applied to a thickness of 10 to 12 inches. Such a thickness of pine straw, however, can be a haven for mice and snakes. Also, pine straw decomposes quickly and washes or blows away quite readily. It is attractive, though, and makes a nice playing surface for the golfer.

Cypress bark mulch is popular in Florida, where few hardwood mills exist. The mulch chunks are actually comprised mostly of wood rather than bark. The entire tree is ground up and the product called mulch is produced. This type of mulch has significantly less insulating quality than other mulches.

The best mulch material is aged, shredded hardwood bark. Oak is the best species from which to obtain this mulch. Hardwood bark mulch has additional advantages if the initial application is comprised of materials that have been aged six months or more. Aged mulch will have already begun to decompose and will not rob soil of nitrogen needed for the decomposition process. If freshly shredded hardwood bark is used, the addition of 10 pounds of ammonium nitrate per thousand square feet assists the decomposition process without draining nitrogen from the soil. For the most pleasing aesthetic appearance, hardwood bark mulch should be double shredded. The highest quality shredded bark contains 2% wood or less and passes through a #2 mesh screen.

Shredded hardwood bark absorbs moisture, protects the soil from heating

(Left) Burlap around the base of a tree acts as a wick that can draw moisture out of the root ball and shorten the life of the tree.

(Below) Shredded hardwood bark mulch helps define areas of the golf course and encourage healthy trees.

Injection of systemic nutrients provides a "shot in the arm" for a sick tree.

and drying, and provides very good erosion control. It does not readily wash or blow away. A three- to four-inch layer is considered ideal for these benefits.

Another advantage of shredded hardwood bark is the fine surface it provides for the golfer compared to thin turf, exposed tree roots, or rocks. A good layer of mulch covers these blemishes and helps prevent wrist injuries and club damage. Golf balls lie on top of the mulch and, contrasted with the dark brown color of the mulch, are highly visible.

Shredded hardwood bark is available from most hardwood sawmills that routinely debark logs. Sawmills that produce bark residues are often listed with the state forester's office/wood utilization branch. Also, the local, state, or regional forest ranger, or a consulting forester, generally knows the sawmills in the area that produce bark residues. The best way to purchase shredded bark is by truckload, which usually costs about $8 to $12 per cubic yard, delivered.

In turf areas where large amounts of mulch is used for definition, a "naked" appearance may be created. In such cases, the establishment of non-competing plants (such as azaleas, rhododendrons, mountain laurel, or flowering trees) is aesthetically helpful in the mulched area.

Dogwoods, serviceberry, redbuds, and others help keep the forest floor cool and moist, and supply leaves that decompose rapidly and provide nutrients.

Fertilization — There is no question that tree fertilization helps improve the health of the trees. The first step is to have a soil test of the area. When the existing soil chemistry is known, fertilizer is applied by broadcasting the proper blends to achieve and maintain an approximate ratio of 1:2:3 between available nitrogen, phosphorus, and potassium in the soil. Fast-release materials are usually selected, since trees prefer a heavy charge of nutrients in the spring and fall to carry them through these growing seasons. Depending on the soil test results, materials such as a 33-0-0, 18-46-0, 13-0-44, or 0-0-60 may be used alone or in combination to achieve the desired levels of nitrogen, phosphorus, and potassium in the soil.

Stressed trees generally respond better to a fertilization technique known as deep-root fertilization and vertical mulching. This process consists of drilling two-inch diameter vertical holes approximately 18 inches deep and two to three feet apart throughout the root feeding area, and filling each hole with a 1:1 mixture of fertilizer and organic matter to produce a higher concentration of nutrients in close proximity to the tree roots. This process benefits

the tree by extracting plugs of soil and creating holes to allow oxygen and moisture to penetrate deep into the root zone, and provides far-reaching benefits for the improvement of "sick" trees or the preservation of specimen trees.

Another technique that is often used to stimulate stressed trees is known as tree injection. This process consists of drilling very small diameter (11/64-inch) holes into the trunk of the tree near groundline, and inserting into each hole a tube to which a capsule containing nutrients is attached. This practice provides a relief to stressed trees and, in fact, can be compared to intravenous feeding for a hospitalized patient.

Natural Phenomenon Precautions — Tree damage from hurricanes, tornadoes, and other natural disasters can be significant and is virtually uncontrollable. However, a superintendent can control the amount of damage caused by normal wind, snow, ice, and lightning through preventative maintenance.

Lightning protection is a key preventative measure for important trees near greens, tees, shelters, and other strategic areas. Lightning protection systems have had a bad image in many parts of the country, unfortunately, because many so-called experts did not know the correct materials to use or the correct methods for installing them. However, a documented failure of a properly installed lightning protection system that complied with the code of the National Arborist Association (NAA) or Underwriters Laboratories (UL) has never been recorded. Golfers are killed each year by lightning, and many of these lives could be saved by installing lightning protection equipment at shelters or trees adjacent to greens and tees or other locations of high golfer concentration.

Proper cabling and bracing prevents tree damage from wind, ice, rain, and snow. Cabling according to NAA specifications involves installing lag hooks or threaded eye-bolts in weak-crotched branches and connecting these with a seven-strand galvanized steel cable of the proper thickness. Such cables are generally installed at a height of two-thirds the distance between the crotch and the top of the tree. They should never be wrapped around a limb or tree trunk.

Regular pruning helps solve many potential problems for trees, turf, and golfers. Pruning may be done to manage tree growth, to lighten the weight of overloaded branches, or to remove hazardous, dead, or dying branches. Pruning may also be helpful, or indeed necessary, to provide sunlight and air circulation for stressed turfgrass or for removing overhanging branches affecting the golfer, especially at greens and tees. Do not remove more than one-third of the green foliage at one session. Also, make sure climbers don't use tree spikes or hooks on their boots, as these wounds attract insects and allow entry points for decay or disease organisms.

Vine and Spanish Moss Management — Spanish moss is very attractive on live oaks in the South. Large populations, however, can disguise hazardous dead limbs or add extra weight to branches. Also, prolific growth of moss within the foliage of a tree can shield the foliage from needed sunlight and cause entire branches to die. To minimize this threat, periodically pull the moss off the foliage at the ends of branches.

Bittersweet, wisteria, kudzu, honeysuckle, grape, and poison ivy are just a few of the vines that grow on trees. As with Spanish moss, a primary concern is to prevent their vigorous vegetative growth from shading the host tree's foliage, or causing breakage of limbs due to excessive vine growth or accumulation of ice and snow. Bittersweet and wisteria are also stranglers, and may twist around stems so tightly that they strangle and kill entire trees. Wisteria can be managed by periodic pruning, but the other species should be killed by severing the vine near the ground and spraying the freshly cut surface with 2,4-D, or by spraying the low-growing vine foliage with Roundup. Herbicide applications should be performed only by licensed applicators, and extreme care should be taken to avoid damage to the tree.

Tree Removal — Many golf courses remove trees only when they are dead, a policy that conflicts with sound tree management and turf management programs. A given area of land can support only a limited amount of vegetative growth. If overcrowded, trees must struggle in competition with others to obtain nourishment, moisture, and sunlight. The weak become weaker (or more deformed), but even the strongest are adversely affected. Selective thinning, as directed by a consulting arborist or forester, removes the less desirable trees and enhances the beauty, visibility, and longevity of the more desirable specimens.

New Tree Plantings — When young trees are planted, it is critical to handle them with care and to reestablish their roots at the same depth they grew in the nursery or in the wild. Planting a new tree six inches deeper, for example, results in the suffocation of a high percentage of its roots. Deep planting also may cause the rotting of the trunk that was previously growing above the ground and exposed to air. Correct placement is very important because only a very small portion of a tree's roots (perhaps only one to three percent) are included in the root/soil ball during digging and transplanting.

It is important to cut and remove the wire or rope that is holding the burlap around the root ball and to lay the burlap in the bottom of the hole. The planting hole should be approximately twice the diameter of the root ball to provide a transition zone into which the roots can more readily develop. During this process the root ball should not be allowed to fall apart. The root ball should also be sliced and major roots directed outward to encourage radial growth. Backfill only with the soil that was excavated from the hole, and be sure there are no air pockets in the planting hole.

Cover the planting area with a three-inch layer of shredded bark mulch, fertilize lightly by broadcasting over the mulch area, and irrigate periodically during the first growing season to keep the roots moist. Most importantly, select only good quality nursery stock, and reject plants with cankered branches, weak crotches, poor form, poor root systems, and other problems.

This information provides a start for a golf course tree management program. Consulting arborists, extension personnel, and others are available to assist the superintendent on specific problems at his course, and should be included in any good tree management program.

A USGA/GCSAA-SPONSORED RESEARCH PROJECT

An Old Grass is Getting a New Look

by **DR. TERRY RIORDAN**
Department of Horticulture, University of Nebraska

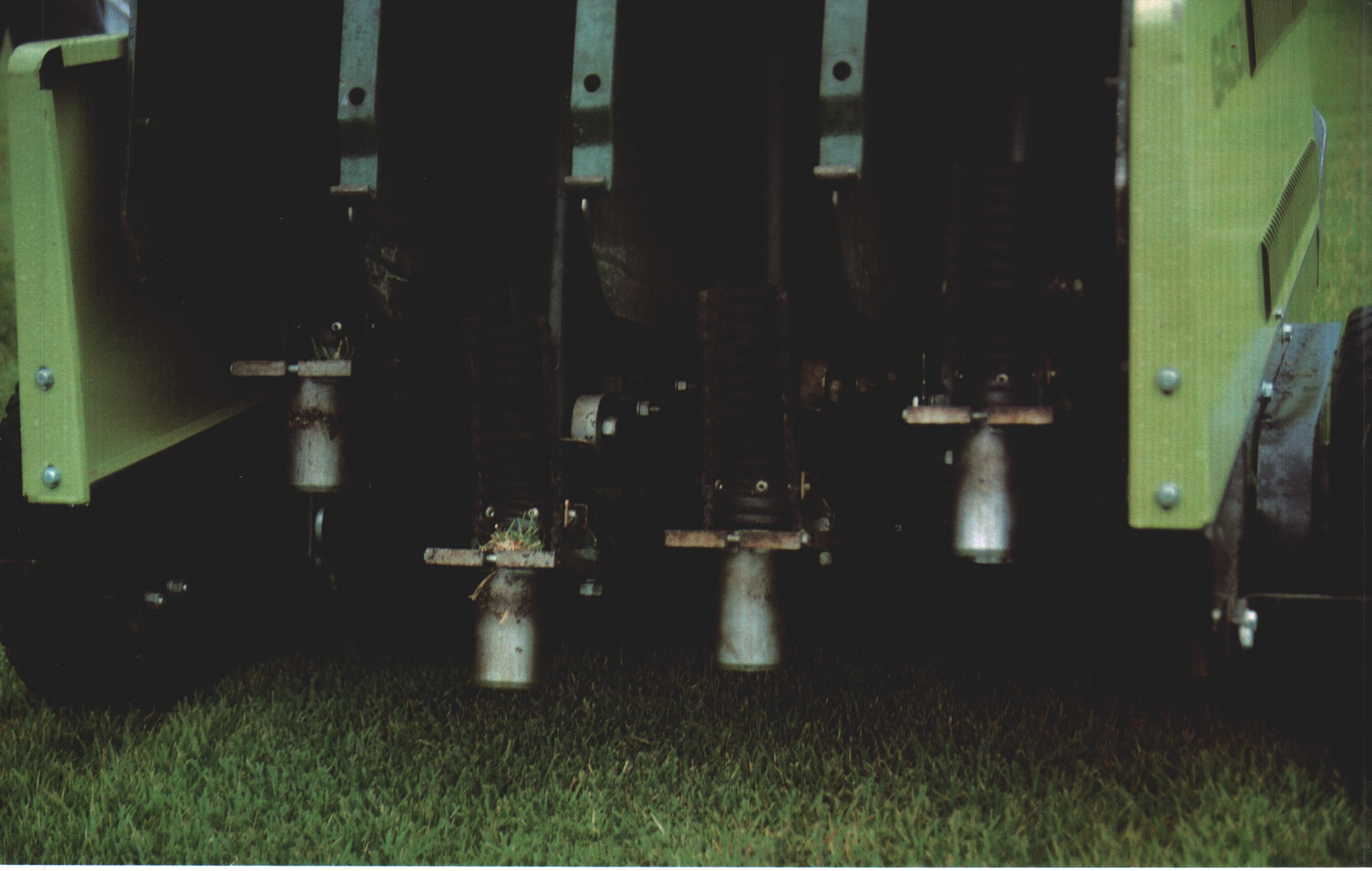
BUFFALO once roamed vast areas of the Midwest plains, which they shared with *Buchloe dactyloides*, a native grass that gained the name buffalograss. Though buffalograss tolerates close mowing and can be found on non-irrigated fairways in the Midwest, it has generally formed an open, low-density turf that has been acceptable only in very low maintenance situations.

The goal of the buffalograss research program at the University of Nebraska is the development of improved vegetative and seeded turf-type buffalograsses which allow golf courses to use less water, fertilizer, and pesticides, and will require less mowing. This is part of a larger overall program funded by the USGA since 1982 that has among its objectives a 50% reduction in water use and certain golf course maintenance costs.

In 1984, Nebraska received approval to start the project. Dr. Ed Kinbacher, of the Department of Horticulture, traveled the Central Great Plains collecting buffalograsses. He also visited Dr. Milt Engelke at Texas A&M to obtain buffalograss from their program, which was about to be discontinued. These clones were planted in the greenhouse along with 200 Texoka and Sharp's Improved buffalograss seedlings.

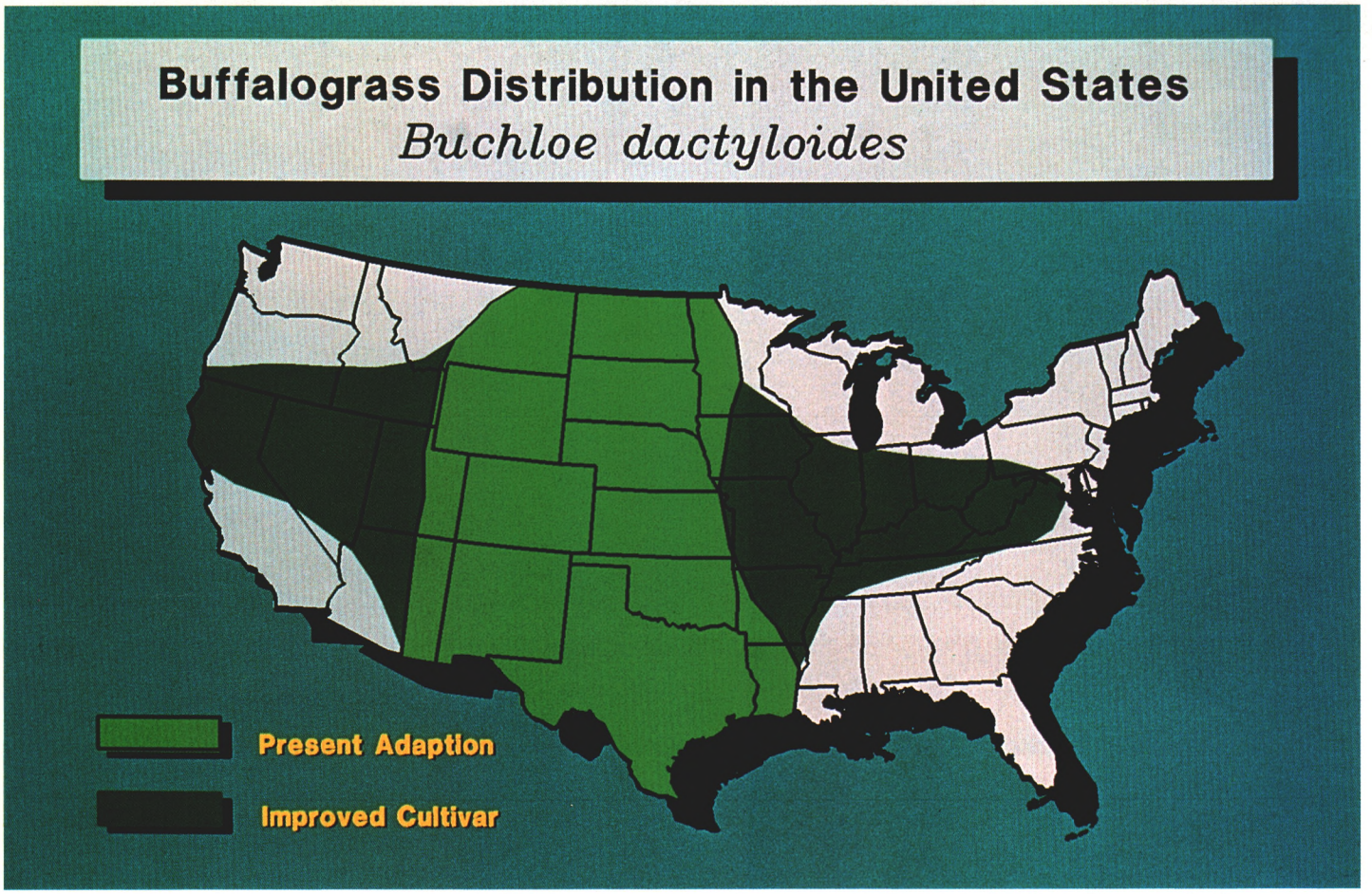
In the spring of 1985, all plant material was established in the field for initial observation, with the belief that it would take at least two years to obtain materials for selection. After just 10 weeks, however, most plots had become completely covered, and it was clear

Buffalograss has the potential for rapid spread by numerous stolons that branch profusely.



(Above) A core aerator has been modified to assist in harvesting buffalograss plugs for propagation.

(Left) Crossing of male and female buffalograss plants in the greenhouse.



Buffalograss is native to a large portion of the central U.S., and improved cultivars have increased its range of use.

that certain strains displayed several desirable turf-type characteristics: dark color, good density, low growth habit, and excellent rate of spread. With encouragement from the USGA, these better selections were increased in the greenhouse during the winter and planted in replicated plots in the spring of 1986. The majority of these plots were covered in 8 to 12 weeks and were being mowed by the fall of 1986.

During the next few years the program focused on the evaluation and development of three new vegetative lines, along with additional research that would set the stage for continued development of improved turf-type vegetative and seeded buffalograsses. The most significant results thus far have involved the development of the three vegetative lines, one of which will be commercially available in the spring of 1991. At Nebraska, several different studies were conducted to ascertain the merits of releasing these three genotypes. In summary, one line was better adapted to the South, and that the other two had adaption both in the South and the North. When placed under minimal maintenance conditions, these three genotypes provide excellent turf quality and require much less management input than other turfgrasses.

After the initial evaluations, tests were arranged with cooperators throughout the United States. Not all tests were successfully established, perhaps because a new species was being evaluated, but buffalograss has done well in the South (Dallas, Texas, and Tucson and Yuma, Arizona) and in other areas of the country (Ithaca, New York; Madras, Oregon; and Ames, Iowa). The most significant application identified by these cooperative tests was the use of this species where water quantity or quality is a problem. Our research has shown that these three lines will use approximately 75% less water than cool-season grasses and will perform well where water is a political and environmental problem.

NE 84-609

The first selection to be released from the USGA buffalograss project is NE 84-609. This clone was selected from material found originally in central Texas. NE 84-609 is obviously adapted to the South, but it has also done well in Nebraska. The positive characteristics of this clone include rapid rate of cover, good density, a dark green color, and excellent fall color (in Nebraska it will stay dark green well into October). NE 84-609 has been licensed by the University of Nebraska to Crenshaw/Doguet Turfgrass Inc., a company located in Austin, Texas. The two principals of this company, Ben Crenshaw (an accomplished golfer, architect, and builder) and David Doguet (former president of the Texas Sod Producers Association) have the experience and expertise to use this grass successfully.

On May 25, 1990, 8,000 pre-rooted buffalograss plugs were planted at the new Crenshaw/Doguet sod farm in Bastrop, Texas. Plugs were planted on three-foot centers into a fumigated sod bed and were irrigated immediately. Because of the rapid spread of this clone, the first harvest was made August 29, 1990, and was used to plant an

additional 20 acres. David Doguet indicates that NE 84-609 is relatively easy to grow, and that it produces an excellent sod. In late October he reported that he had planted approximately 225 acres of buffalograss, including Prairie (a Texas A&M introduction) and NE 84-609, for sale in 1991. Considering that less than one acre of buffalograss has ever been grown and sold, this is a very ambitious, innovative project. However, David Doguet feels that meeting the present golf course market would require over 1,000 acres.

The Crenshaw/Doguet Company currently has sub-licensed the material to a production group in Florida, and they anticipate having growers in Arizona, New Mexico, and California. In 1991 both NE 84-609 and Prairie will be available via shipment from Texas. By 1992 they will be locally available throughout the South.

Other Vegetative Selections

Two other vegetative buffalograss selections will be released by the University of Nebraska in 1991. Both selections are northern types which should do well in the North and in the transition zones of the United States. One surprise, however, is that one of the selections is doing very well in Austin and Dallas, Texas, suggesting a broader adaptation. These selections will probably be commercially available in 1992.

The Nebraska buffalograss development program is continuing, and in 1990 over 100 new selections were made from various evaluation plots and nurseries. Several of these selections show characteristics which promise even better buffalograsses for the future. Initially, the turf-type buffalograss selections were all female, since the female plots exhibited excellent quality with no visible flowering stems. The more recent selections do include a number of male selections which have excellent turf quality and attractive male flowers. These may function quite well in a golf course rough, defining the fairway while allowing golfers to find their golf balls and hit shots with an acceptable penalty.

Seeded Buffalograss Development

The University of Nebraska has entered into agreements with two commercial producers of buffalograss seed to market the seed of new turf-type buffalograsses. Developing a seeded buffalograss takes more time than developing a vegetative cultivar because of the breeding methods involved and because there are the two sexes in buffalograss. Other turfgrasses have the male and female flowers on the same plant. Much of the research effort by our graduate students at Nebraska involves the development of breeding techniques and screening procedures necessary to develop improved turf-type buffalograsses.

During the last two years excellent progress has been made in developing seeded buffalograsses. Based upon the current outlook, at least three to five seeded buffalograsses will be available for testing during 1991. These experimentals exhibit good turf quality, good color and density, and consist of both male and female plants. The business plan for both production groups calls for the marketing of a seeded buffalograss in 1994.

Plug Production and Establishment

The philosophy of our buffalograss development project is that it is necessary both to develop a new cultivar and to find a way to deliver the cultivar to the market. Market access is especially important for a new vegetatively propagated species.

Among the several advantages to developing a vegetative cultivar, the most important are the reduced time it takes to develop the cultivar and the uniformity obtained from a vegetatively propagated clone. Initial vegetative increases of selected material for plot evaluation were made using a hand plugger obtained commercially for $10. There was an attempt to improve this plugger, but when costs approached $100 with no improvement, this project was discontinued. Using this plugger, one person could harvest 300 plugs per hour, which is satisfactory for research work.

As the project continued, it was obvious that plugs were an excellent way to propagate buffalograss. When the plugs were pre-rooted for four to eight weeks and planted on 12- to 15-inch centers, plot coverage was obtained in 10 to 12 weeks.

When graduate students began requesting 5,000 to 6,000 plugs for experiments, a graduate student from biological systems engineering offered assistance in designing a mechanical plug harvester. With assistance from Lincoln-based Cushman Corporation, the student was able to obtain a Cushman GA-30 and modify it to harvest plugs. The easily modified GA-30 is capable of harvesting 38,000 two-inch plugs per hour. This single piece of equipment has allowed rapid harvest of plant material for research and initial foundation plantings of new grasses. It is hoped that the Cushman Corporation will make this modification available for use by sod growers and golf course superintendents.

Buffalograss Management

Critical to the acceptance of buffalograss in the turfgrass market is the knowledge of how to grow it. Buffalograss is a low-maintenance turfgrass, but it does require proper management. Research at UNL has provided the following recommendations:

1. Fertilize with 1 to 2 lbs. nitrogen per growing season with applications around July 1 and August 15.
2. Irrigate when necessary to maintain color and active growth (i.e., water deeply and infrequently). Typically, this is about once per month in the northern U.S. and more often in the South.
3. Mow weekly to maintain a high-quality turf and every four to six weeks for a golf course rough.
4. The need for pesticides is rare, but use a pre-emergence weed control material when necessary. There are always exceptions, but buffalograss is relatively weed resistant, and most weeds can be controlled by mowing.

If buffalograss is over-managed (too much fertilizer and water), weeds can become a problem. Buffalograss is not very competitive, and weeds are more responsive to intensive management. Maintaining inputs at an optimal level for buffalograss will encourage the buffalograss and discourage the weeds.

Summary

Participating in the development and improvement of buffalograss has been very rewarding. New turf-type buffalograsses will produce an excellent turf for many golf course rough areas, and more importantly, reduce the need for water, fertilizer, mowing, and pesticides on the golf course. This project, funded by the USGA, has fostered the development of new cultivars, the technology necessary to produce sod, plugs, and seed, and the knowledge necessary to manage this species when used for turf.

Greens subject to poor air circulation and shade do not dry as quickly as greens in more exposed locations. They often exhibit symptoms of poor drainage even though the soil mixture may be equivalent to apparently well-drained greens on other parts of the course.

Finding Solutions for Poorly Drained Greens

by JAMES T. SNOW
National Director,
USGA Green Section

SEVERAL YEARS AGO the Sports Turf Research Institute in England surveyed all of the golf courses in Britain and found that a full 80% considered that they have at least one poorly drained green. If a survey were done of American golf courses, the results would probably be quite similar.

There is no telling how much time and money are spent dealing with these problem greens on golf courses, but it must be substantial. There is little that is more aggravating or worrisome than a poorly drained green during periods of wet weather, especially when temperatures are high or traffic is heavy. Turf on poorly drained greens is generally more susceptible to disease incidence and stress injury, and the soil on such greens is more prone to compaction than greens that drain well.

For golf course superintendents who have managed poorly drained greens, the symptoms are easy enough to identify. They often include thin turf, shallow roots, compacted surfaces, greater disease, increased traffic injury, mower scalping, algae encroachment, footprinting, and a predominance of *Poa annua*.

Good drainage and poor drainage are relative terms. If all greens could be incorporated into a graph, it would probably show a bell-shaped curve, with a majority of greens in a broad "mediocre" range as far as drainage is concerned. What this means is that many greens could be drainage problems under a certain set of circumstances, even though they drain satisfactorily much of the time. Golf course

architects and builders who say they never lose greens to poor drainage even though they don't test their materials through a laboratory are kidding themselves and their clients. What they fail to say, or don't understand, is that many of these "low cost" greens can be a real headache during wet weather even though they may not fail completely. Many of their greens fall into the "mediocre" category.

When a golf course superintendent classifies one of his greens as poorly drained, it doesn't necessarily mean that the soil in that green is of poor quality. What he should say is that under these climatic conditions, in this location on this golf course, and under this particular cultural management program, this green drains poorly. Under a different management program, at a different site on the same course, or in an area that receives less rainfall, for example, this same green might be considered well drained.

The message is this: There are many factors that can contribute to a green being considered poorly drained, and there are many things that can be done to shift a green from the "poor" to the "satisfactory" category. Among the practices that need to be considered are irrigation management, tree effects, dealing with traffic, and drainage installation.

Irrigation Management

The fact is that many greens diagnosed as being poorly drained are actually overwatered. It is telling, for example, when a new superintendent takes over a course, that he is able to eliminate the poor drainage symptoms from certain greens by instituting a different irrigation program or by redesigning or remodeling the irrigation system. After all, overwatering can be due to improper irrigation practices, poor irrigation system design, or both.

Following are symptoms that could indicate poor drainage characteristics, poor irrigation practices, or both. If these symptoms are observed consistently during the season, even during periods of dry weather, then they are more likely an indication of overwatering. If quite a few of these symptoms are commonly identified on your course, then perhaps your irrigation program needs attention.

- Puddling after irrigation (indicates poor irrigation design or coverage).
- Deep-pitted ball marks.
- Spike marks and wear injury around the cup.
- Complaints of wet shoes after walking on greens.
- Triplex ring symptoms (wet, lush turf is prone to traffic injury).
- *Poa annua* encroachment.
- Poor stress tolerance.
- Weak root growth.
- Heavy spring irrigation (when it is often not needed).
- Disease activity (e.g., pythium, brown patch).
- Black layer.
- Manual irrigation system (coverage and control are often poor).
- Lack of cultivation (causing surface runoff or slow infiltration).
- Lack of use of a soil probe (should be used to monitor soil moisture).
- Lack of a hand-watering program (no automatic system can do it all).
- Insufficient daily visual monitoring.
- Insufficient monitoring of the maintenance needs of the irrigation system.
- Isolated dry spots (indicates poor irrigation coverage).
- Black algae.

It is not uncommon for poor irrigation practices or a poorly designed irrigation system to be the actual cause of what many people might consider to be a poorly drained green.

The Effects of Trees

It is more than coincidence that the greens that superintendents identify as being poorly drained on their golf courses are often the ones located in a pocket of trees. On most of these

A sand topdressing program established a compaction-resistant growing medium on this green during a five-year period. The green improved significantly and rebuilding was avoided in this case.

In this instance, poor surface drainage was corrected by removing the sod, regrading the soil, and replacing the sod.

courses, all of the greens were built at the same time and constructed of the same materials and in the same manner. Why, then, should these certain greens exhibit symptoms of poor drainage?

The answer to this question has to do with the environment in which the green is growing. The trees that surround these greens block air circulation through the area and may cast shadows on the turf, preventing the soil in the greens from drying as quickly as other greens on the course. They quite literally stay wet for a longer period of time than the others, and exhibit symptoms of poor drainage such as disease activity, algae and moss encroachment, poor tolerance to traffic, poor root development, etc. This prolonged period of wetness also makes them more subject to soil compaction, a factor that compounds the drainage problem.

This problem is made worse yet by careless irrigation practices on these greens. Since they stay wet for a longer period of time, greens located in pockets of trees should not be irrigated as often or as heavily as other greens. Superintendents who do not recognize this and who don't make the necessary adjustments often blame the subsequent turf problems on poor soil drainage.

The solution to this drainage problem is sometimes as simple as removing or thinning out a few of the nearby trees to improve sunlight penetration and air circulation. Adjustments to the irrigation program may also have to be made. If trees cannot be removed for some reason, or if these practices do not work, then the traditional methods of drainage or reconstruction may have to be used.

The Effects of Traffic

Many greens that exhibit adequate drainage characteristics under light to moderate use can develop poor drainage symptoms when subject to heavy traffic. When a municipality takes control of a private club, for example, this scenario is quite common. It also can occur when a switch is made from walk-behind greensmowers to triplex greensmowers.

The cause of the problem in this situation is compaction in the upper part of the root zone. Water infiltration is reduced in compacted soils, causing runoff and puddling symptoms in many instances. Also, compacted soils do not dry as quickly, compounding the problem even more.

When poor drainage symptoms occur due to the effects of heavy traffic, cultivation practices should be increased. Core cultivation, followed by core removal and topdressing with a sandy, compaction-resistant material, should be practiced as often as necessary to improve and maintain good water infiltration. Deep-tine cultivation may

be needed on soils that are being affected at a greater depth.

Green design sometimes impacts the effects of traffic. For example, heavily trafficked greens that lack adequate cupping area can show severe symptoms of surface compaction and poor drainage in the most common hole locations. By redesigning the green to expand hole location areas, these symptoms can sometimes be greatly reduced or eliminated.

When traffic problems occur on walk-on and walk-off areas, redesigning the green or the nearby sand bunkers can sometimes relieve the symptoms. Also, switching to walk-behind mowers for part or all of the time can significantly reduce traffic effects.

Dealing with Poor Drainage

If drainage symptoms persist, even though the problems mentioned previously have been addressed, then a more direct approach to solving the drainage problem will be needed. First, the cause of the drainage problem in the green needs to be determined. It could be one or more of these three possibilities:

- Poor surface drainage.
- Poorly drained soil.
- Layering problems.

Poor surface drainage is often recognizable by the surface puddling that occurs after light to moderate rainfall or irrigation. It stems from poor green design or settling after the green was built.

Poor surface drainage can be overcome in several ways, depending on the extent and severity of the problem. In some cases, low spots can be eliminated by selectively topdressing the area on a light, frequent basis. Where a broader area is involved, sod may have to be removed, the subsurface regraded, and the sod replaced. In some instances, the entire surface may have to be stripped, regraded, and resodded, or be rebuilt completely. Sometimes, nothing at all needs to be done if good surface infiltration can be maintained with a program of regular core cultivation.

When poorly drained soil is the cause of the problem, developing a solution is usually a matter of degree. Where the problem is not too severe, a good pro-

Deep-tine aerification or drilling can improve drainage if there is a layer or compacted zone in the upper 10 inches of the profile.

gram of core cultivation, core removal, and topdressing with a sand or high-sand-content material affords relief over a period of years. Deep-tine aerification also can be incorporated into the program for faster results.

Where the symptoms are severe, the addition of drainage tile to the green may be necessary. The installation of 2″ to 4″ plastic perforated pipe sometimes works quite well, though the disruption to the putting surface can sometimes take years to eliminate. Various types of sand injection systems and geotextile-covered drainage systems have been tried, but in many instances the results have been insufficient or temporary. If a green has a long history of drainage problems, the best solution is to rebuild to USGA specifications.

Layering problems caused by poor construction, topdressing inconsistencies, or some other factor, can sometimes be overcome by breaking through the layer and allowing water to reach the well-drained soil below. This is accomplished by regular core cultivation or deep-tine cultivation, depending on the location of the layer. If the coring holes are filled with sand, real progress can be made in overcoming the effects of the layer. In a more severe case, it may be necessary to add drainage tile. Greens that do not respond well to these techniques should be rebuilt to USGA specifications.

Summary

Green drainage problems aren't necessarily what they appear to be. Poor irrigation practices, tree effects, and traffic effects sometimes mislead golf course superintendents into thinking they have a drainage problem. On greens where poor drainage is identified, the cause of the problem could be 1) poor surface drainage, 2) poorly drained soil, or 3) layering problems. The cause must be determined before a good solution can be developed and implemented.

The installation of drainage tile in an existing green sometimes works very well, but the appearance and playability of the green may suffer for quite some time.

Field Testing For Better Management

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

WHEN golf course superintendents get together, it is not uncommon to hear statements like, "I can't believe how this new fertilizer has improved rooting, drought tolerance, and disease resistance in my greens," or, "when I applied that material, the grass just headed south." Such disaster stories could be avoided, and the many jubilant claims substantiated, if these superintendents would follow through with an objective field testing program.

Field testing seems to be a lost art in today's hectic golf course environment, yet it can be a very effective means of sorting out new fertilizer or pesticide products, and determining at what rates those products are most effective under local conditions. Testing also allows the superintendent to become familiar with adverse or unusual product effects prior to wide-scale application to his course, and it can be an effective demonstration tool when new equipment or management programs are being considered. Membership support for programs is often easier to obtain following a successful demonstration.

The testing of various products and practices has always been a part of golf course management. Green Section publications dating from the 1920s and 1930s provide excellent accounts of golf course field tests for turf varieties and various insecticides, fungicides, and herbicides. The bentgrass "pie trials," conducted at many prominent golf courses beginning in 1939, were critical to the development of vegetatively propagated creeping bentgrasses of that period. The majority of today's testing, unfortunately, is left to universities and commercial entities. Results of these tests are very useful, but the information is not always applicable to conditions faced in the field. Financial and resource limitations also limit the amount of testing that can be done at most universities. Following are some basic guidelines and insights to consider when field testing new products on your golf course.

Field testing programs can vary from extensive, elaborate experimental designs to a simple comparison between products, equipment, or cultural practices. Limiting the test to a simple design in which one or two products or practices are tested is recommended because it simplifies the analysis of the results. The actual test should be thoroughly planned. It is important to design the test to provide specific data or results that satisfy the particular objective of interest to you or the club. Once the test has been formulated, a basic plot plan and site selection can be completed.

Selecting a good site for your test is critical. The site should be representative of the golf course, and if a pesticide product is being tested, the site should have a history of pest activity. Comparison tests between various materials or practices should be conducted on uniform sites to limit the variability that could affect the results. If several sites on a course are used for comparison testing, products or variables should be tested at each site. For example, if two pesticides are being compared, be sure both products are tested at each site; never compare the performance of a product applied to one site to a second product applied to a different site. Replicating a simple test on several sites (for instance two greens or several fairways) provides a more accurate representation as long as the sites are similar in turf composition, soil types, and microenvironments.

It is not recommended that herbicide or growth regulator testing be done in highly visible locations or on heavily trafficked areas where turf loss cannot be tolerated. Likewise, common sense suggests that initial testing work not be done on greens in play if the playability of the turf might be adversely affected. Instead, these tests should be done on a practice green or putting green nursery.

Once a site has been selected, a map or plot plan can be designed simply by dividing the selected site into separate equally sized areas designated as treatment plots. A basic plan might divide a green, approach, tee, or fairway area in half, treating one section consistently while leaving the other as a control (not treated). However, even better results could be achieved by dividing a sampling site (green or fairway) into a series of smaller plots and then replicating the treatments. The design for such a test might include two or three plots for each treatment, including control plots.

It is important to include control plots as part of the design. Control plots receive no treatments and serve as a basis for comparison. All treatments should be assigned randomly (e.g., pick numbers from a hat) to the various plots. Assigning the treatments is completed on the plot map before any applications are made. Several copies of the plot map and designated treatments should be made to serve as application and reference guides during the life of the field test. Test plots can be sized to match the width of a spray boom, spreader pattern, or any practical dimension. A 6″ to 12″ buffer zone separating the plots eases treatment applications and simplifies final observations.

After the plot design has been mapped, the site itself can be clearly marked to avoid confusion with applications and evaluation work. Many good trials have been destroyed because of unclear marking or poor communications. There are a number of markers, inconspicuous to the golfer, that can serve as permanent boundary guides.

An effective, commonly used marker is a small, square aluminum plate containing a center hole. The small marker plate is located at the soil-thatch interface at the plot corners along the site boundary and secured with a 6″ spike. Pressure-treated wood pegs also serve

(Above) Plot boundaries are marked with twine or string fastened to spikes that protrude through corner markers.
(Opposite page, top) Control plots are required for any objective comparison.
(Opposite page, bottom) A disaster that could have been avoided with an initial trial application.

as effective markers. The brightly painted wooden markers can be implanted flush with the soil. They can be installed in rough areas, adjacent to putting greens and other closely cut turf, to avoid interfering with play or maintenance activities.

Permanent markers are helpful as application guides and for observation and photographic purposes. String or twine is most often used to line plots from marker to marker, providing a definite outline of the treatment or demonstration site, as well as each individual plot.

Once the plots are marked and the treatments initiated, it is important that the sites be uniformly maintained. Staff communications are very important at this point to avoid misapplications or practices that might affect the test results.

Application rates and treatment frequency depend on the specific products or practices being tested. Pesticide products should be applied according to label rates and instructions. Fertilizer comparisons should be based on rates that provide the same nutrient concentrations in the field, and the applications should be patterned after a typical program. If a new product is to be tested, the applications can be varied between high and low label rates to determine which rate is most effective under the specific test conditions.

Analyzing the trial correctly is also important to obtain useful information. If at all possible, have other parties not familiar with the applications complete the review as well. Their observations are sometimes more objective. It is also helpful to maintain a written record of various observations (weather conditions, unusual pest activity, etc.) during the test. The analysis can be a simple visual comparison of turf quality, or it may require estimating percent damage or pest number per plot. Other trials or demonstrations may not require any formalized analysis or observations, as the goal of the test is to determine the program's overall effect on turf quality or play (e.g., lightweight mowing programs or growth regulator trials). An open line of communication should be maintained with the membership throughout the testing period. Solicit membership or committee opinions and cooperation in examining the test's results.

Finally, when product results are compared, it is important to closely analyze the findings to determine the validity of field observations and results. Consider possible variables that may have influenced the trial. Repeating the trials through another season might be considered if the results are inconclusive.

In summary, many golf course superintendents would benefit from applying a few simple scientific principles when evaluating new products or programs. The tests do not have to be elaborate or complex to be effective. Additional information concerning specific field testing procedures can be obtained by contacting university faculty or county extension agents. Graduate students, too, are often willing to cooperate with superintendents in practical field research and testing. The wealth of information obtained from these tests can be extremely beneficial, and will help you and your course get the most for every maintenance dollar.

NEWS NOTES

DR. KIMBERLY S. ERUSHA APPOINTED TO GREEN SECTION STAFF

The Green Section is pleased to announce the appointment of Dr. Kimberly S. Erusha to the newly created position of Manager, Technical Communications. In her new role, Dr. Erusha will expand the Green Section's ability to provide its 15 regional agronomists and USGA member clubs and courses with the most up-to-date information concerning turfgrass science and golf course management programs.

Dr. Erusha graduated with a B.S. degree in horticulture from Iowa State University, and completed her M.S. and Ph.D. degrees in the Department of Horticulture at the University of Nebraska. Her work in graduate school included the investigation of turfgrass wear and drought tolerance mechanisms, and the effects of irrigation and potassium treatments on Kentucky bluegrass turf cut at fairway height.

Prior to graduate school, Kimberly served as Extension Associate in the Turfgrass Integrated Pest Management program at the University of Nebraska, where she was responsible for coordinating the pest surveillance program and preparing training programs, publications, audiovisual materials, news releases, and other educational materials and programs. She has a number of research and extension publications to her credit, and was responsible for the production of a videotape concerning the control of thatch on home lawns.

Kimberly is a native of Walford, Iowa, and has recently relocated to New Jersey, where she will be based at Golf House.

NANCY P. SADLON NAMED ENVIRONMENTAL SPECIALIST

In filling a new position that reflects a critical issue for golf in the 1990s, the Green Section has named Nancy P. Sadlon as Environmental Specialist. Nancy comes to the USGA from a position as supervisor of the Environmental Department in The Chester Partnership, a large consulting firm based in Laurence Harbor, New Jersey. There she was involved in providing clients with a wide array of environmental and landscape architecture services, including environmental impact statements, wetland delineation reports, wetland mitigation plans, and landscape design plans.

Nancy is a graduate of the Landscape Architecture program at Rutgers University — Cook College with a B.S. degree in environmental planning and design. She has extensive postgraduate training in wetlands issues, including studies of wetland ecology, soils, plant materials, and related regulatory issues, and has more than 10 years of field experience dealing with wetland issues as a consultant.

In her new position, Nancy will be responsible for coordinating the USGA's environmental education activities. She will work in close cooperation with the New York Audubon Society in expanding its Audubon Cooperative Sanctuary for Golf Courses program. She will also be involved in making on-site visits to golf courses, writing articles for newsletters, bulletins, and other publications, and participating in turf- and golf-related meetings and seminars.

Nancy is a New Jersey native and will be working out of the USGA's headquarters at Golf House in Far Hills, N.J.

JIM LATHAM RECEIVES WISCONSIN GCSA AWARD

The Wisconsin Golf Course Superintendents Association honored Great Lakes Regional Director Jim Latham with its Distinguished Service Award on the 25th anniversary of the Milwaukee Turf Symposium in October. Acknowledging Latham's significant contributions to the symposium as a speaker and planning committee member over the 25-year history of the event, the WGCSA noted that Jim is one of only two people to have attended every single symposium.

The award carries special significance in that it is given so seldom; it has been awarded just eight times in the history of the Association. His associates on the Green Section staff congratulate Jim for this well-deserved recognition.

TURF ADVISORY SERVICE FEE CHANGES FOR 1991

To keep up with the increasing costs of providing quality advisory services to its member clubs and to the game of golf, it has been necessary for the USGA to increase the fees charged for the Green Section's advisory visits. Following is the fee schedule for 1991:

	If paid by May 15	After May 15
Half-day visit	$700	$850
Full-day visit	$1200	$1350

Despite the increase this year, it is noteworthy that the fee for a half-day Turf Advisory Service visit has not even doubled since 1972, when the fee was $360. A Green Section visit is still a bargain for the many benefits that can be realized, maybe more so now than ever. Please join us for great golfing turf in 1991!

IN MEMORIAM

Dr. Fred V. Grau, 88, Director of the Green Section from 1945 to 1953, died at College Park, Maryland, on December 1, 1990. Dr. Grau was instrumental in the development of crown vetch, a perennial legume used for erosion control, slope stabilization, and beautification programs along the nation's highways.

Dr. Fred Grau, right, looking at zoyziagrass selections with Art and Jack Snyder in October 1952 at the Beltsville Research Station.

Dr. Grau obtained an undergraduate degree from the University of Nebraska in 1931 and studied for his master's degree at the University of Maryland, where he became a research assistant for the Green Section. He earned his Ph.D. in 1935 and joined Penn State as the first turf extension agronomist in the United States. During his tenure with the Green Section he played an active role in the research and development of "Meyer" zoysiagrass, "Merion" Kentucky bluegrass, and U-3 bermudagrass.

After leaving the Green Section in 1953, he initiated research projects promoting grass species and maintenance practices requiring lower water, fertilizer, and pesticide inputs. He also actively promoted high-quality athletic turfs to reduce sports-related injuries. Dr. Grau was awarded the 1969 USGA Green Section Award.

Green Section Announces 1991 Regional Conferences

Following is a list of the regional seminars organized by the USGA's Green Section and Regional Affairs staffs for 1991. For more information about these programs, contact your regional Green Section office.

JANUARY

10 Wyndham Hotel, Palm Springs, California

MARCH

12 NCR Club, Dayton, Ohio

12 Royce Hotel, Palm Beach, Florida

13 Riverside Country Club, Bozeman, Montana

14 Orange Lake Country Club, Orlando, Florida

19 Fiddler's Elbow Country Club, Bedminster, New Jersey

21 Saginaw Country Club, Saginaw, Michigan

26 Lakewood Country Club, Dallas, Texas

27 SCGA/USGA Industry Hills Golf Club, City of Industry, California

28 Bellerive Country Club, St. Louis, Missouri

28 NCGA/USGA Castlewood Country Club, Pleasanton, California

APRIL

2 Carmel Country Club, Charlotte, North Carolina

2 Lakewood Country Club, Denver, Colorado

4 Weston Golf Club, Weston, Massachusetts

9 Country Club of Rochester, Rochester, New York

9 Tacoma Country and Golf Club, Tacoma, Washington

16 Country Club of Little Rock, Little Rock, Arkansas

17 Paradise Valley Country Club, Paradise Valley, Arizona

ALL THINGS CONSIDERED

JUST DO IT!

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

THE RECENT annual conference of the American Society of Agronomy reinforced several themes that golf course superintendents should keep in mind.

First, the entire meeting focused on the effects of agriculture (including turfgrass maintenance) on the environment. Believe it or not, there are still superintendents who feel this whole issue is being blown out of proportion and will eventually fade away. They are badly mistaken.

Second, every researcher I spoke with feels efforts should be made to reduce chemical usage. Scientists, better than anyone else, recognize the futility of attaining a 100% understanding of how chemicals (fertilizers and pesticides) interact with the environment. The general consensus is that we cannot completely eliminate the use of these products now or in the near future without severely affecting turfgrass quality. However, from a practical standpoint (both environmentally and politically), reductions should begin immediately.

We all hear a lot of vague references to "organic" methods and "natural" products. (Try to find a cereal on the shelf that does not use "natural" somewhere in the product description.) Thus far, many of these products have not proven very well suited to large areas subjected to environmental pressures from nature and humans — the golf course. While such options are worth trying, in my opinion most are not capable of achieving a large-scale reduction in chemical use at this time. Many superintendents have taken a wait-and-see position, perhaps in the hope that researchers and industry will develop products that are viewed by all as safe and will support the goal of perfection on the golf course. This is an unrealistic view of the present state of affairs.

So what is a superintendent to do? This brings me to my third point. You have to start somewhere. How many of you have honestly made an attempt to reduce chemical use?

The most common excuse for not reducing chemical use on the golf course is that the membership will not tolerate less than what they have now. How do you know? You are their industry expert. Have you prepared and presented to them a reduced chemical usage plan? Have you given them the chance to accept less than perfection in terms of weed, insect, or disease control? Backing away from perfection will allow you to use less chemicals and save money in the process. Your membership is not oblivious to the issues confronting the turf industry and society in general. Have you given them options to consider, or have you already decided for them?

Just do it. Prepare a maintenance plan that relies as little as possible on fertilizer and pesticides. Include the removal of trees that limit air movement to greens and tees. Include the reconstruction of greens that drain so poorly they require constant attention to keep them alive. Include tolerating weeds that may be an eyesore but do not threaten the course agronomically. Include a reduction in fertilization done strictly for color. Include the additional people necessary to scout the course for disease and insect problems. Early diagnosis will allow you to use lower rates and perhaps eliminate a few preventative applications. Include better cart traffic control so the turf does not become thin and subject to weed invasion. Include higher cutting heights on greens (yes, slower greens) to facilitate developing stronger, healthier plants that are less prone to stress of all types.

Your membership may well say no to all or part of such a plan. At least give them the opportunity. Just do it.

USGA Green Section Educational Conference

in conjunction with the 62nd

GCSAA International Conference and Show

Las Vegas, Nevada — Tuesday, February 12, 1991

ENVIRONMENTAL OPPORTUNITIES IN THE 1990s

8:00 - 8:15	**Welcome** Raymond B. Anderson, Chairman, Green Section Committee, and Member, USGA Executive Committee
8:15 - 8:30	**The Best Turf Tips from the Green Section Staff** Larry Gilhuly, Director, Western Region John Foy, Director, State of Florida Region Dave Oatis, Director, Northeastern Region
8:30 - 9:30	**Looking at the Environment from Three Angles** Richard Klein, President, Community and Environmental Defense Associates Rees Jones, Golf Course Architect James T. Snow, National Director, USGA Green Section
9:30 - 9:45	**Canada Geese — Waterfowl or Just Plain Foul?** George Thompson, CGCS, Country Club of North Carolina, Pinehurst, North Carolina
9:45 - 10:05	**Issues in Golf in the 1990s** C. Grant Spaeth, President, United States Golf Association
10:05 - 10:25	**More Top Turf Tips from the Green Section Staff** Jim Latham, Director, Great Lakes Region Jim Skorulski, Agronomist, Northeastern Region Tim Moraghan, Agronomist for Championships Jim Moore, Director, Mid-Continent Region
10:25 - 10:40	**Responsible Stewards of the Land — An Opportunity** Gerald Faubel, CGCS, Saginaw Country Club, Saginaw, Michigan, and President, Golf Course Superintendents Association of America
10:40 - 11:10	**The Story of Shadow Creek** Steve Wynn, Chairman of the Board of the Mirage Hotel
11:10 - 11:30	**More Top Turf Tips from the Green Section Staff** Pat O'Brien, Director, Southeastern Region Paul Vermeulen, Agronomist, Western Region Jim Connolly, Agronomist, Northeastern Region Stan Zontek, Director, Mid-Atlantic Region
11:30	**Closing Remarks** Mr. Anderson

USGA GREEN SECTION RECORD
JANUARY/FEBRUARY 1991

TURF TWISTERS

WHAT DO I NEED?

Question: Do I need a computer to utilize the information contained in the TGIF library? (Pennsylvania)

Answer: No, you do not. In fact, you can ask for a literature search simply by calling (517) 353-7209 and speaking with Carol Case or Peter Cookingham. You can also send requests by mail to:

Turfgrass Information Center
Michigan State University
Library W-212
East Lansing, MI 48824-1048

The library is there to serve, for a nominal fee, anyone in the industry who needs information. TGIF is more than electronic: There are people there who are ready and willing to help fulfill your information needs, whether you have a computer or not.

FOR GREAT GREENS

Question: Is USGA "spec" green construction really necessary for bermudagrass greens? (Florida)

Answer: Though Tifdwarf and Tifgreen bermudagrasses are aggressive turf types, and thus more tolerant of a poorer growing medium compared to the bentgrasses, present-day player demands are pushing the limits of adaptation of the bermudas. Therefore, if top-quality putting green conditioning and a healthy turf are to be successfully maintained, proper construction is absolutely essential. The specifications for a method of putting green construction developed and recommended by the Green Section offer the highest degree of assurance that the type of green conditioning desired can be provided, regardless of the type of grass selected.

BESIDES PRUNING TREES

Question: Our club is considering a major tree pruning and removal program which we hope to initiate during the winter months when regular operations are slow. Concerns were raised, however, as to the effect of winter pruning on the trees. When is the best time to prune trees, and is winter pruning detrimental? (New York)

Answer: Light or remedial tree pruning can be completed anytime. However, pruning trees in early to mid-spring assures rapid wound healing during the first season. Golf courses frequently do initiate pruning and removal programs during winter months for ease of operation and limited interference from play. Generally, winter programs can be carried out successfully with no adverse effects on the trees. In areas where temperatures plummet below 0° F for prolonged periods, tissue damage adjacent to pruning wounds has been reported on several conifer species. It is not recommended to prune spring flowering trees during the winter season, since many flower buds are removed. Pruning each species immediately following full bloom will promote its flowering next season. Finally, avoid late-winter pruning of maples, birch, elm, or other species which bleed profusely. Bleeding can usually be avoided by scheduling the operation for early winter or following leaf break.