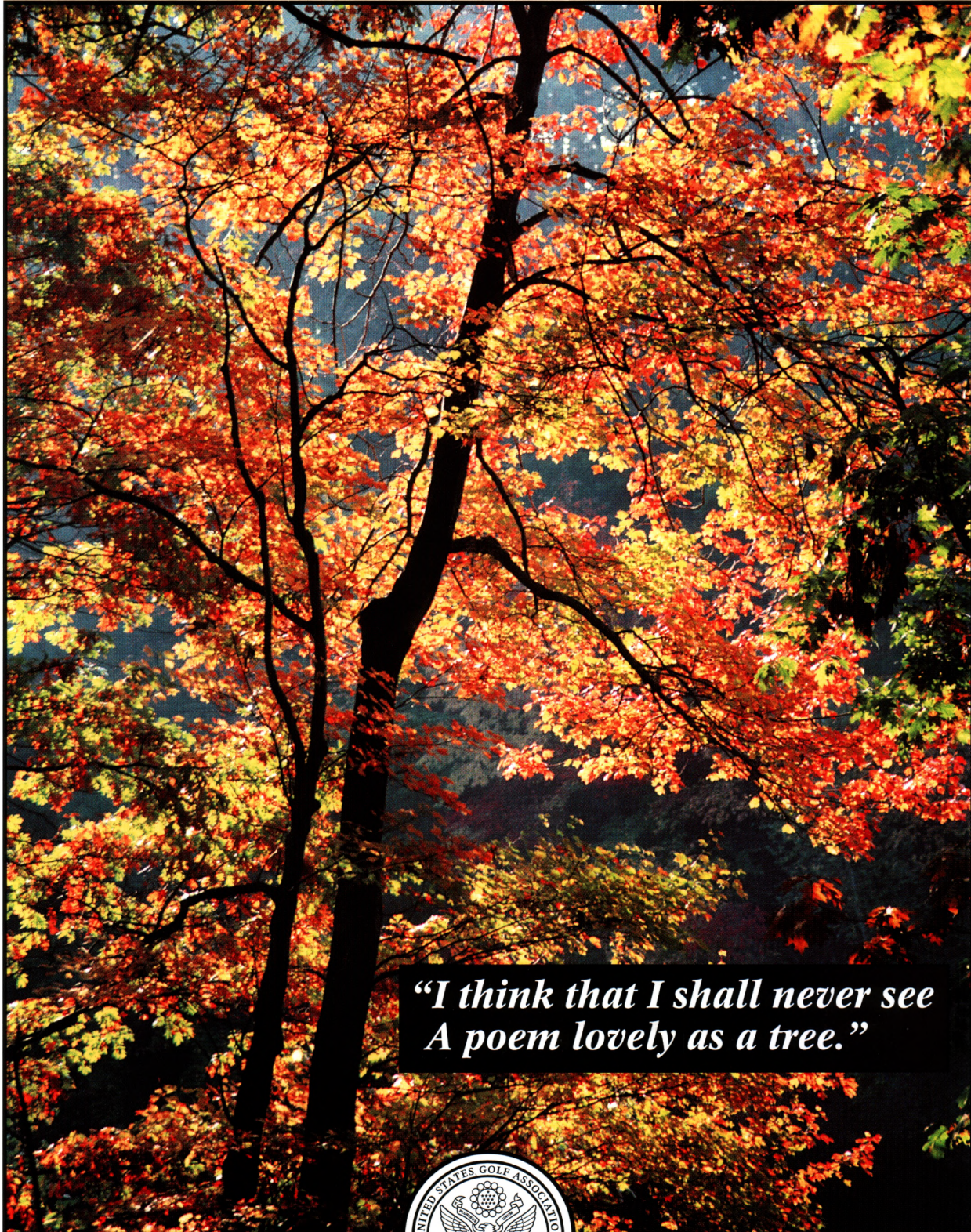


USGA® GREEN SECTION **Record**

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*"I think that I shall never see
A poem lovely as a tree."*



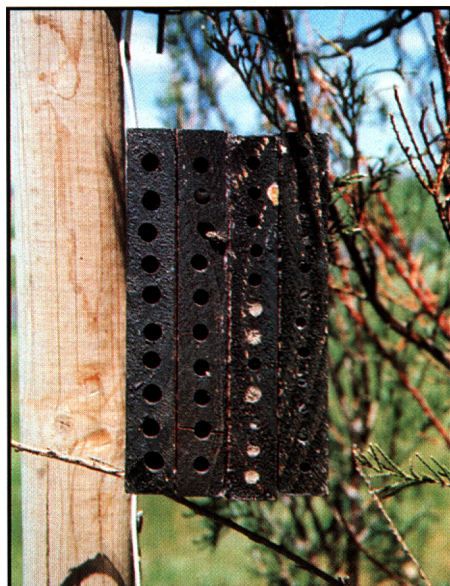
A PUBLICATION ON TURFGRASS MANAGEMENT

BY THE UNITED STATES GOLF ASSOCIATION®

*Cover Photo:
Trees have inspired poetry . . .
and can cause a considerable
amount of trouble for golf
course superintendents.*



Sometimes the stump of a tree removed for agronomic reasons can be put to artistic use on the golf course. For more about dealing with trees, see page 1.



XERCES SOCIETY PHOTO

A wooden block, drilled with holes $\frac{3}{32}$ " to $\frac{3}{8}$ " in diameter, quickly becomes home for solitary nesting bees. See page 17.

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by DAVID A. OATIS

Trees by Joyce Kilmer

I think that I shall never see
A poem lovely as a tree.

A tree whose hungry mouth is prest
Against the earth's sweet flowing
breast;

A tree that looks at God all day,
And lifts her leafy arms to pray;

A tree that may in Summer wear
A nest of robins in her hair;

Upon whose bosom snow has lain;
Who intimately lives with rain.

Poems are made by fools like me,
But only God can make a tree.



"As beautiful as trees are, and as fond as you and I are of them, we still must not lose sight of the fact that there is a limited place for them in golf. We must not allow our sentiments to crowd out the real intent of a golf course, that of providing fair playing conditions. If it in any way interferes with a properly played stroke, I think the tree is an unfair hazard and should not be allowed to stand."

— Donald Ross, from
Golf Has Never Failed Me

JOYCE KILMER had no idea of the damage that trees can inflict upon golf courses when he penned his immortal poem, "Trees." This is a poem that many adults can quote or at least recognize immediately, and it is the epitome of how many people feel about trees.

Fortunately for golfers and golf course superintendents, master architect Donald J. Ross also commented on trees. In his book *Golf Has Never Failed Me*, Mr. Ross spoke volumes in his simple, straightforward statement. Many courses would do well to take his message to heart. America has a love affair with trees, and there is much to love. Trees provide us with many practical and environmental benefits, and they are a phenomenon of nature that most find fascinatingly beautiful. Planting trees is an enjoyable pastime that



Planting trees too close together results in problems in later years. Crowded conditions result in neither tree developing its natural shape.



Trees that block advancement from a hazard are sometimes referred to as double hazards. The solution in this situation is straightforward — remove or relocate the bunkers or remove the trees.

can leave us feeling that we have made a lasting and beneficial mark on the earth. Since many of our home lawns are small, there often is limited space available to plant trees. For golfers, it is only natural that their tree planting efforts frequently are transferred to the biggest landscape they know, the golf course.

The Problem

Most golf courses start out or eventually become overplanted with trees, and they eventually begin to suffer through all of the associated problems. Overplanting is inevitable for most courses. Once it occurs, the turf declines, playability suffers, views are lost, and the golf course gradually acquires a closed-in, claustrophobic feel. A common result of overplanting is that good golf holes are made unfair or just overly penal, and they become less enjoyable to play. Distinguishing design features frequently are obscured, the original intent of design is lost, and the altered holes wind up becoming gimmicky. It is at this point — when the care of the golf course and the turfgrass begins taking a back seat to the tree plantings — that the course

begins a slow downward agronomic spiral.

Sometimes tree planting is taken to ridiculous extremes. This often is something that happens at courses where a “tree committee” or a “course beautification committee” has been appointed. Such committees can provide an invaluable service, but they also can get carried away. It only makes sense. After all, what is the duty of the tree committee if not to plant trees? Tree removal is often extremely unpopular, and at some courses, every tree becomes sacred, no matter how deformed, unhealthy, or unsafe it becomes. Trees and tree planting must never be allowed to interfere with the fundamental objective, which is to grow healthy, reasonable-to-maintain turfgrass on which to play the game.

Tree problems come in a variety of forms, but they basically revolve around quantity, quality, and location. The wrong (species) tree in the wrong location can be disastrous for the turf. It also can greatly increase the cost of golf course maintenance. By now you might be concerned over the trees on your course, and you may be wondering just what you could do to determine

whether or not your course has tree problems and just how severe they are. What makes for a good stand of trees? How does a course assess its tree situation?

Getting Started

For years, Green Section agronomists have helped golf course superintendents and committees pull their courses out of the tree-induced death spiral, but it requires plenty of hard work and communication. Golfers and board members who are willing to listen and be educated are a prerequisite. Over the years there have been many articles written on the subject of trees and their impact on playability and turfgrass health. A list of some of the better ones is included at the end of this article. Reading these articles is a great place to start for any course that is ready to get serious about its trees.

A quick tour of any course by a trained professional can quickly reveal whether extensive tree work is needed. However, considerably more time is required to determine the full extent of the work required. Although rare individuals have the knowledge and

expertise to do an evaluation without assistance, the most prudent course of action usually is to perform a systematic evaluation, utilizing professionals from different disciplines. In this manner, the different perspectives can be discussed. The following are some good possibilities:

- Golf course superintendent
- Agronomist
- Arborist
- Golf course architect
- Golf professional
- Interested committee members

The goal should be to select a committee with varied backgrounds so all issues are considered. Starting the review process with the proper criteria on which to base decisions is critically important and should influence the selection of committee members. Depending on the size of the property, the number of plantings, and nature of the problem, effective and thorough tree reviews may take a few days to complete. The work identified may be so extensive that it could be scheduled in phases over a couple of years.

Although it may seem an overwhelming task, an excellent approach often is to evaluate each tree individually. Some courses have gone so far as to mark each tree in one of four ways:

- Prune
- Remove
- Relocate
- Do not touch

This time-consuming approach forces conscious decisions to be made regarding the fate of each tree and can result in better decisions. Just be sure to use a non-permanent marking system so that changes can be made easily. It also helps if the marking system is discreet, as this will help avoid calling attention to the program and unnecessarily alarming golfers. Small pieces of color-coded plastic tape, stapled to the trees, work well. Marking paint also can be used but can be too persistent. In the Northeast, mid/late September is an ideal time to perform the review, with the work being carried out during the fall and winter months.

The Criteria

Next come the criteria, and this is where many courses get off the track. There are many reasons to plant and maintain trees, but the reasons should be reviewed, especially for trees that are having a deleterious impact on the course. Perhaps the first question to ask regarding such a tree is, "Does the tree

have a specific purpose?" or "Is this tree necessary?" It certainly is not essential for every tree to have a specific purpose, but this is a good place to start for trees that are having an undesirable agronomic impact on the turfgrass. If the answer is no, the solution is straightforward. The following are some of the appropriate criteria to be used in the decision-making process:

- The desirability of the tree based on its species
 - Golfer safety
 - The general health of the tree, including its form and structure
 - Life expectancy
 - The impact on playability
 - The impact on the agronomics of growing turfgrass
 - The impact on traffic flow
 - The impact on aesthetics and surrounding trees



A tree simply cannot be valued above a human life. Unsafe trees in heavy traffic areas need to be addressed quickly and should be removed.

The desirability based on species:

Certain species are inherently more valuable than others. In fact, a guide for determining tree valuation has been developed by insurance companies with the help of the National Council of Tree and Landscape Appraisers. Because of the requirements of the game in general, and the turfgrass in particular, many species of trees are not well suited to use on golf courses. Fast growers, soft-wooded, or species with invasive roots are among the first to avoid. Dense canopied trees that cause excessive shade or create especially severe penalties to golfers are best

left unplanted. Species that create litter or have severe pest problems also should be avoided. It gets even more complicated because species that may work well in one climate may be totally inappropriate in other climates. Regrettably, there are no perfect species, and selection often involves some trade-offs.

Golfer safety: Safety likely is the most serious consideration when evaluating trees. Tree failure cannot always be predicted, but trees with obvious structural problems must be removed, particularly when they are located in high play/traffic areas. Surprisingly often, large, damaged, severely declining trees are allowed to remain even though they may pose a serious injury threat to golfers or maintenance staff. This is an example of emotion getting the best of intellect. Simply put, preserving an old, dying, and obviously unsafe tree must not take precedence over protecting the health and well-being of human beings. No tree is worth more than a human life, but if the value of a human life is not enough to convince some, talk to the insurer—perhaps the liability issue will!

General tree health including form and structure:

If the form, structure, or species is poor or undesirable, it should be considered for removal. Specific knowledge of trees and their growth habits therefore is essential, which is why an arborist should be included in the review process. This is not to say that all imperfectly formed trees should be removed; on the contrary, it is the nature of some tree species to have an irregular growth habit. The northern white pine (*Pinus strobus*) is just such an example. Mature specimens usually display an irregular growth habit, often as a result of ice damage, which can be quite attractive. On the other hand, trees with naturally symmetrical growth habits that are somehow damaged and wind up misshapen, should be considered for removal. Trees that have to be over-pruned for playability reasons also fall into this category.

Life expectancy: Most tree species have predictable life expectancies that are greatly influenced by their care and location. A properly trained arborist can take the myriad of factors that affect individual trees into account and provide an estimate of a tree's life expectancy. This is not an exact science, but taking a tree's potential life span into consideration is helpful in long-term planning. It simply does not make sense to spend money on corrective

pruning, pest control, or fertilization for trees affected by a serious or incurable malady. Removal is usually the most fiscally prudent decision.

The impact on playability: Playability can be a gray area because there are few hard and fast rules in golf course architecture. However, an overriding principle to keep in mind is that "golf is a game, not a penance," and as such, it should be enjoyable. Trees that unfairly penalize one segment or another of the golfing population may not be appropriate. Dense canopied trees with low branching habits (cedars, spruce, etc.) present an extreme penalty, and usually are not appropriate in high-play areas. The following are a few other situations to avoid:

- **Double hazards:** Trees or brush located in or in front of hazards (e.g. sand bunkers) that block advancement generally should be avoided. The game is hard enough without making it overly penal!

- **Vegetation blocking play from a teeing ground:** Why build and maintain a tee that cannot fairly be used?

- **Vegetation blocking play from a significant portion of a fairway:** A player who has hit a ball in the fairway deserves a shot at the green.

- **Design alteration:** Indiscriminate tree planting can have an insidious impact on a good design. Do some of your tees point into the woods? Do some of the doglegs seem too severe? If so, chances are good that trees have altered the original intent of your design.

The impact on the agronomics of growing turfgrass: It is a well-known fact that trees compete effectively with turfgrass for moisture, nutrients, and sunlight. Some trees are worse offenders than others, and some turfgrasses are better adapted than others to handle the shade and root competition. However, in many situations trees and turfgrass simply are not compatible. If healthy, wear-tolerant turfgrass is to be maintained, the trees have to go.

Turfgrass grown in a shady, pocketed environment is physiologically different from turf grown out in the open. Reduced sunlight affects the growth habit of the turf, causing it to be more open and "leggy," much the same as a houseplant grown with insufficient sunlight. This leaves the turfgrass more succulent and susceptible to wear injury. Under low light conditions, the turfgrass also will suffer from reduced vigor. A good rule of thumb is that grass needs at least

eight hours of direct sunlight to exhibit moderate recuperative power, and turf that receives extra stress, wear, and tear (i.e. greens and tees) will perform better with even more light. Thus, trees that block sunlight must be considered for removal. All things being equal, morning sun is more valuable (e.g. for drying the turf) than afternoon sun, so concentrate efforts there first. Also realize that sun angles change dramatically throughout the year, and performing sunlight assessment without taking seasonal changes into consideration is a major mistake.

The other major effect trees and brush can have is in reducing air circulation. Reduced air circulation translates to increased temperature and relative humidity, and this favors the growth and development of many turfgrass pathogens. In summary, a poor grass-growing environment creates less vigorous turf that is more susceptible to injury and infection. When the turf suffers injury, whether it is through wear, fungal infection, nematodes, or insect infestation, the damage is enhanced and the recovery is hampered by the lack of adequate sunlight.

In many cases, superintendents are successful in overcoming poor grass-growing environments and are able to produce good playing conditions despite the handicap of a poor environment. However, few will dispute the added cost and extra effort involved. For golfers wishing to minimize the use of pesticides, the poor grass-growing environment will prove difficult to deal with. Failure to provide turf with its most basic needs clearly increases labor requirements and the use of pesticides. It also is the limiting factor in achieving the desired level of playability. All of this translates into more expensive golf.

The impact on traffic flow: The placement of any physical obstruction in a high-traffic area results in concentrated and impossible-to-manage wear problems. When the obstruction is a tree, the problems with the turf are magnified because of the added stress of tree root competition and shade. Thus, it is recommended to refrain from planting trees or other vegetation in high-traffic areas. Keeping these areas as open and unobstructed as possible will result in healthier and better playing turf.

The impact on aesthetics and surrounding trees: Although it is well understood that trees compete with turf, one must remember that trees also



Some trees, due to structural weaknesses, are not good choices. If the trees provide strategic value to the golf course, they should be replaced with a better species.



It takes some imagination to envision that the cute little shrub in a one-gallon container will eventually grow into a golf ball-swallowing monster!



compete with trees. It is entirely appropriate to mass trees in some areas, perhaps to create definition or separation. However, stand-alone specimen trees also are desirable and can have dramatic visual impact. It is not recommended to make every tree a specimen tree, but highlighting and exposing some of the better ones is certainly worthwhile. Golfers will be allowed to appreciate a magnificent tree they might otherwise completely overlook.

Many courses have hidden specimen trees that are worthy of exposing and highlighting. Stop for a moment and try to recall your favorite golf course trees. More than likely, you are recalling trees that are 75 or 100 years old or more and are exposed and uncluttered with other plant material.

Tree spacing also should be carefully checked. Trees planted too closely will be sickly, stunted, and deformed, and they will never be able to achieve their full potential. Even if there are no specimen trees involved, culling out the less desirable trees may be worthwhile. The turf and the remaining trees will benefit from the reduction in competition, which also may extend the life span of the trees. This type of tree work can enhance the appearance of the course since it amounts to "getting rid of the clutter." Reducing competition among trees and choosing potential specimen trees for the future is a wonderful gift for future generations.

High-Tech Sunlight Assessment

For critical areas where safety and/or particularly valuable specimen trees are

involved, it might be worth utilizing a high-tech sunlight assessment technique. It takes all of the guesswork out of tree removal and can predict how much light will be gained by doing specific tree work before the work is actually done.

Concentrate on Quality Rather than Quantity

That golfers love to plant trees is a simple fact of life. Planting a tree is to leave a lasting mark on the landscape of our courses. Memorial trees are especially popular, particularly because of the emotion associated with the loss of a loved one. Unfortunately, memorial tree programs can result in emotional and indiscriminate tree planting. When the number of monuments or plaques that often accompany memorial plantings accumulates, it can create an undesirable cemetery-like feel.

It must be noted that a comprehensive tree program must also include planting trees, but all potential plantings should be reviewed in the same manner as suggested for reviewing existing trees. Few programs can ruin a golf course more quickly than overzealous tree planting. There clearly are many valid reasons for planting trees, but a good rule of thumb is to "Never plant a tree without a specific purpose in mind." Remember, planting trees can be expensive, but the costs for years of care, leaf removal, and eventual removal are much higher. Overplanting is an expensive mistake that future generations have to bear. Most courses

would do well to *concentrate on quality rather than quantity* when it comes to planting trees.

Conclusion

By now, some readers may be chomping at the bit to get out their chainsaws. So, should you go out blindly and begin cutting trees down? No, but you should undertake a systematic and unemotional review of your trees. Once the review has been completed, develop options for scheduling the needed work. Utilizing large-scale land clearing equipment, some courses have removed several hundred trees in just a couple of weeks. Other courses take a more conservative approach and spread the work out over several fall and winter seasons. Since tree removal work can be upsetting to golfers, it usually is best to schedule it for the off-season.

In all likelihood, much of the work needed will be straightforward. However, there may also be some very difficult decisions to make along the way. Removal of the "no-brainers" is a good place to start. These are the trees that have no redeeming features, and getting them out of the way first usually makes the tough decisions easier. These might be trees of the wrong species or ones located where they are interfering with turfgrass health or playability.

Next, look for any specimen trees that might exist on the property. If they are in good health, have a reasonable life expectancy, and make sense architecturally, carefully cull out the competing trees to expose the better ones.



The products of a poor grass-growing environment include thin, weak turf, moss, algae, and increased pesticide usage.



Trees with invasive root systems, both above and below the surface, wreak havoc with the turfgrass, golfers, and maintenance equipment.

Trees take a long time to grow, and there is nothing wrong with having to come back and revisit some of the more complicated situations.

Ultimately, the goal of a thorough tree review is to promote healthier turfgrass and better playability. Properly carried out, this comprehensive program also will create a better stand of trees.

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Sand-Based Rootzone Modification with Inorganic Soil Amendments and Sphagnum Peat Moss

Current player volume and maintenance practices call for research into changes in putting green construction materials.

by CALE A. BIGELOW, DAN BOWMAN, and KEITH CASSEL

"The pace of golf activity and traffic on golf courses is presently at a peak which has never been equaled. Many of our construction methods that were satisfactory before, will no longer produce greens which will withstand the wear now imposed upon them."

THESE WERE THE WORDS that prefaced the 1960 Green Section specifications for a method of putting green construction. Although we have had a widely accepted system for constructing putting greens for nearly 40 years, it seems that the same words also hold true today.

Four years ago, in an effort to further understand and improve putting greens, the USGA supported a series of scientific research projects at universities across the United States. One of the projects, entitled New Materials and Technologies for Putting Green Construction, was conducted at North Carolina State University. In this study we evaluated a variety of materials that could be used to amend sands used in putting green construction.

Basic Principles of Sand-Based Rootzones

Since 1960, the most widely accepted method of putting green construction has specified a high sand content rootzone. Sand is well suited for high-traffic areas like putting greens because it resists compaction, drains quickly, and maintains good aeration properties. Also, it is relatively inexpensive and generally is available most anywhere. Although sand is a good substrate for putting green rootzones, it does have limitations, most importantly poor water retention and nutrient retention.

To correct these deficiencies, sand has most often been amended with peat moss (Beard, 1982). Although peat moss may be the frequently used soil amendment for putting greens, other materials may also be suitable. As with any organic material, peat moss de-

composes over time. This gradual decomposition may adversely affect the rootzone physical properties and this, in turn, may contribute to poor performance of turfgrasses grown on these declining rootzones. Turfgrass researchers have evaluated many inorganic soil amendments for sand rootzone construction with mixed success (Waddington et al., 1974; Schmidt, 1980; Ferguson et al., 1986; Nus and Brauen, 1991; Kussow, 1996; Carlson et al., 1998; McCoy and Stehouwer, 1998).

Renewed interest in inorganic soil amendments has resulted in many products being marketed for turfgrass

areas. A few of the more commonly used inorganic soil amendments are the porous ceramics, diatomaceous earth, and zeolites. Some of the characteristics of these products that potentially make them desirable for improving the properties of sands are a large internal porosity that results in water retention, a uniform particle size distribution that allows them to be easily incorporated, and high cation exchange capacity that retains nutrients. Therefore, research exploring the suitability of newly marketed inorganic soil amendments that are not subject to biological degradation, but still provide water and nutrient retention, would be worthwhile.



A wide variety of soil amendments are available for amending putting green sands.

Table 1
Particle size distribution, geometric mean diameter, and particle density of three sand size classes and five rootzone amendments used for the simulated putting green rootzone mixtures

Amendment	Particle Size							Geometric Mean Diameter	Particle Density
	mm								
	>2.0	1.0	0.5	0.25	0.10	0.05	<0.05		
	g kg ⁻¹							mm	Mg m ⁻³
Fine sand	0	0	0	0	1000	0	0	0.01	2.62
Medium sand	0	0	0	1000	0	0	0	0.25	2.62
Coarse sand	0	0	1000	0	0	0	0	0.50	2.62
Ecolite	0	<1	242	615	139	1	3	0.67	2.32
Greenschoice	0	3	871	108	11	7	<1	0.84	2.15
Isolite	0	5	446	534	10	5	<1	0.74	2.27
Profile	0	<1	0	714	272	14	<1	0.59	2.50
Sphagnum peat	–	–	–	–	–	–	–	NA	0.63

Considerations Before Selecting an Amendment

Before deciding on which amendment to use for improving the properties of a particular sand, you should consider a few questions. What effect will the amendment have on the overall particle size distribution of the rootzone mixture? Too many coarse or fine particles is undesirable. What impact will the amendment have on the chemical properties of the sand? Some amendments may dramatically change the soil pH or contribute unwanted nutrients. How stable is the amendment? Will it physically or biologically degrade and potentially clog up the drainage pores of the rootzone mixture? Lastly, it is important to consider availability and cost. An amendment could have the best physical and chemical properties in the world, but if it needs to be shipped across the country the benefits may not warrant the cost. Since all amendments do not have identical characteristics, an overview of some of the major properties of the more commonly marketed amendments follows.

Types of Amendments

There are essentially two major classes of amendments: 1) organic materials, which are derived from decomposed plant materials, and 2) inorganic materials, which are mineral based.

Organic materials are typically expensive and, depending on the origin, may be somewhat short-lived in the rootzone. The benefits of adding organic matter to most any soil are

numerous. It does an excellent job of enhancing soil structure by improving aggregation and can be an excellent substrate for microbial growth. Increasing aggregation also enhances soil aeration, which may ultimately improve turfgrass health.

In addition to the structural benefits, most organic matter can hold several times its weight in water. When taken advantage of in coarse-textured soils, this property can greatly improve moisture retention. A certain amount of organic matter improves the resiliency or the ability of soils to withstand traffic.

In addition to improving soil physical properties, organic matter may have moderate nutrient-holding capacities, depending on soil pH. If an organic material is used for soil modification, it is important to use well-decomposed materials because they are more stable and less likely to negatively impact the physical properties that you have worked so hard to achieve.

Inorganic materials are derived from large, naturally occurring mineral deposits, and these products are generally mined from the ground. These products range from low to high in cost, depending on the particular material and its availability. Several inorganic materials have been marketed over the years for soil modification. Some of the more commonly used products include: calcined clays, porous ceramics, expanded shale, diatomaceous earth, and the zeolites.

Calcined clays, also marketed as porous ceramics, are products that have been heat treated at a very high temperature (1000-1800°F). This heat-

ing increases the structural integrity of the particles while retaining their chemical properties. Once calcined, most products are often screened to a uniform particle size that makes them well sized for use in putting green rootzones. Since these products are clays by nature, they also have a very high inherent moisture-holding capacity. This high moisture retention is the result of many small internal pores. Earlier research has suggested that particles comprised of many small pores may hold moisture so tightly that it may not be available to plants (Davis et al., 1970). Another benefit of these clay-based minerals is that, because they are clays, they have some nutrient-holding capacity, particularly for cations like the ammonium (NH₄⁺) ion.

Diatomaceous earth is a material that has been mined from deposits of diatom shells. Diatoms are one-celled ocean organisms whose cell walls consist of interlocking parts and valves containing silica. The skeletons of these diatoms have a high degree of internal pore structure, and thus, like the clays, retain significant quantities of water. These products have been marketed with and without clay binders. The clay addition certainly affects the water-holding capacity of the product. Like the clay-based amendments, the availability of water to plants and the long-term stability of these materials is not fully understood.

Zeolites are a relatively new class of amendments being widely used for turfgrass rootzones. The main attraction of zeolites is that they are tremendous absorbers. They have long been used in removing environmental pol-

lutants and in many industrial processes. Some zeolites have even been fed directly to livestock to improve gastrointestinal performance. The use of these minerals in turf has become popular because they have a strong affinity for cations. In fact, the cation exchange capacity (CEC) of some zeolites has been measured at 200 cmol./kg or more (Ming and Mumpton, 1989). For comparison, the CEC of quartz sand is < 1 cmol./kg. Zeolites do have internal porosity and hold significant amounts of moisture, but generally do not retain as much as the clay-based products.

The primary interest in using these materials is for improved nutrient retention. Several university studies have documented dramatic reductions in fertilizer needs in zeolite-amended sands (Nus and Brauen, 1991; Huang and Petrovic, 1994). Currently, some of the zeolite products are being sold "pre-charged" with fertilizers. Applications of these zeolites may be like applying fertilizer and improving CEC all at once. Theoretically, the plant is able to use the fertilizer contained in the zeolite, and it can be "re-charged" by subsequent fertilizer applications.

One precaution when selecting a zeolite is that some of the zeolites may have rather high residual sodium contents, which is harmful to turfgrasses in large quantities. Therefore, before purchasing a zeolite, it is advisable to determine how much, if any, sodium may be present. As with the other amendments, the long-term particle stability under turfgrass cultivation and freeze-thaw cycles is still undefined.

Materials and Methods

Experiments were conducted to examine the suitability of several commercially available inorganic amendments for use in sand-based rootzones. Specifically, amendments were tested to determine their effect on the physical properties of three contrasting sand size classes and their ability to limit nitrogen leaching. A locally available quartz sand was mechanically screened into three uniform size classes (fine: 0.1-0.25 mm, medium: 0.25-0.50 mm, and coarse: 0.5-1.0 mm). Five amendments (two porous ceramics: Profile and Greenschoice; a diatomaceous earth containing a clay binder: Isolite; a clinoptilolite zeolite: Ecolite; and sphagnum peat moss) were studied. Amendments were tested at two rates (10% or 20% by volume).



Diatomaceous earth contains many small diatoms that possess a large network of internal pores.

The following physical properties of the amendments, sands, and the respective rootzone mixtures were measured: particle size distribution and density, water retention, bulk density, and saturated hydraulic conductivity (percolation rate). Nitrogen leaching was determined using amendments mixed with a predominately medium-sized sand. Rootzone mixtures (12" deep) were installed in acrylic cylinders placed above a 4" layer of gravel, saturated and drained for 24 hours. A liquid solution of ammonium nitrate, equivalent to 1 lb. of N per 1,000 sq. ft., was applied to the surface of the rootzone mixtures and leached with distilled deionized water. The effluent was collected and analyzed for the presence of ammonium and nitrate.

In addition to the laboratory analysis, a field study was conducted to determine the effect of some of the amend-

ments on creeping bentgrass establishment when mixed at 10% by volume in a medium-sized sand. The sand/amendment mixtures were installed into field plots constructed according to USGA guidelines (USGA, 1993). The experimental greens were then seeded to creeping bentgrass in October of 1997 at the Turfgrass Field Laboratory in Raleigh, N.C. Creeping bentgrass establishment was rated visually by percentage ground cover until full coverage was achieved. Due to space limitations, only a portion of the data collected in the entire study will be presented in this article.

Results and Discussion

Physical Properties

Porosity and Water Retention: Sand size significantly affected porosity and water retention. Fine sand had the greatest total porosity of the three size classes but was not significantly different from medium sand, which was similar to coarse sand. Although fine sand was similar to medium sand for total porosity, the pore size distributions and inherent water retention were very different. Fine sand contained almost 20% less macropores, or air-filled pores, than either medium or coarse sand. Although fine sand had less air-filled pores, it had much higher > 20% capillary water retention, measured at a -40cm tension.

Capillary water retention is a very important property of a rootzone mixture because it represents free water

Table 2
Porosity and water retention of three sand size classes and five rootzone amendments

Rootzone Component	----- Porosity -----			----- Water Retention -----			Bulk Density
	Total	Macro	Capillary*	-20cm	-500cm	AWHC**	
	----- Percent (%) -----						
							g cm ⁻³
Fine sand	45.0 c	18.2 b	26.8 bc	44.6 b	2.5 c	24.4 a	1.42
Medium sand	42.9 c	37.8 a	5.1 d	14.8 d	2.9 c	2.2 c	1.47
Coarse sand	38.4 c	34.7 a	3.7 d	4.7 e	0.6 c	3.1 c	1.59
Ecolite	60.6 b	37.2 a	23.4 c	24.7 c	20.6 b	2.8 c	0.87
Greenschoice	56.7 b	32.1 a	24.6 c	25.0 c	20.8 b	3.8 c	0.84
Isolite	72.2 a	36.4 a	35.8 b	36.1 b	34.2 a	1.6 c	0.59
Profile	73.4 a	38.0 a	35.4 b	39.6 b	33.2 a	2.2 c	0.64
Peat moss	74.4 a	22.4 b	52.0 a	61.5 a	34.3 a	17.7 b	0.15

*Capillary porosity refers to water retained at -40cm

**Available water holding capacity (AWHC) equals capillary water retention minus -500cm

Means followed by the same letter in the same column are not significantly different under Fisher's protected LSD (p = 0.05)

that remains after gravitational drainage stops. Thus, most of this water functions as water that may be used for plant growth. As a benchmark, most successful sand-based rootzones contain $\geq 15\%$ water by volume (Bingaman and Kohnke, 1970). In addition to capillary water, another important property of a rootzone mixture is the available water-holding capacity.

For these experimental rootzone mixtures, available water was defined as the difference between water retained at a -40cm and a -500cm tension. The -500cm tension was selected as the theoretical "permanent wilting point" because under most normal putting green irrigation cycles a rootzone would rarely be allowed to exceed this value before resupplying water. For comparison, many soil scientists commonly calculate available water for field crop soils as water retained between a -333cm and a -15,000cm tension. The difference between putting green soils and field crop soils is that under natural field systems the soils often possess more silt and clay, are much deeper, and often contain a much deeper rooted unmowed crop. Thus, the -500cm value seems more appropriate for our shallow, coarse-textured putting green rootzone system.

With that in mind, fine sand retained significantly more water at all soil water tensions than any sand, and most importantly, had 10 times the available water than either medium or coarse sand alone. Further, the medium and coarse sand had capillary water retention less than 6% and a correspondingly very low available water status. If these sands were to be considered for constructing a sand-based putting

green rootzone, they would certainly need to be amended.

Comparing the amendments by themselves to the sands showed that the amendments had significantly greater total porosity than any of the sands. Total porosity for each rootzone component ranked in the order: peat moss = Profile = Isolite > Ecolite = Greenschoice > fine = medium = coarse sand. Peat moss, Profile, and Isolite had greater than 70% total porosity, compared to the sands, which had 40-45%. Both peat moss and the inorganic amendments had 10% to 28% greater total porosity than the most porous sand, fine sand.

These data illustrate that in order to have such high total porosities, the inorganic amendments must possess a relatively large internal pore space. These internal pores probably account for much of their water-holding capacity. The percent air-filled pores were generally similar, > 30%, for all amendments and the medium and coarse sand. The corresponding percent capillary pores were highest for the inorganic amendments Profile and Isolite, > 35%, and lowest in Greenschoice and Ecolite, with < 25%, but still greater than any sand.

Although porosity is an important property for relatively shallow rootzones like putting greens ($\leq 12"$), another important property is the amount of water released at a relatively low tension (-20cm tension) and how much water remains at the defined wilting point (-500cm tension). These data provide information regarding overall amendment particle size, pore size architecture, and possible field performance. For example, if an amendment

releases most of its water at a relatively low tension and retains little at a moderate tension, it is probably composed of relatively coarse-textured particles and may be of little use in an already coarse-textured medium like sand. Conversely, if an amendment releases little water at low tensions and retains significant amounts at high tensions, this amendment is probably composed of many very small pores, a situation that also may be undesirable because the water might not be available to the plant during stress periods.

In these experiments, all sands and amendments except fine sand released 28% to 36% of their water between saturation and -20cm. Water released at this low tension is associated with gravitational drainage and generally would not be retained in rootzones exceeding 8" depth. In contrast to these rapidly draining sands and amendments, fine sand released only 0.4% of its water at this low tension. Thus, the fine sand retains a rather substantial amount of water, which may be useful as rootzone depth increases.

To further characterize the moisture release properties of the amendments and three sands, water retention data were collected for a range of increasing soil water tensions. Each rootzone component seemed to have a characteristic tension where most of the water was released. This critical tension appeared to be directly related to particle size, with finer textures requiring higher tensions to release water. For example, coarse sand abruptly released most of its water between -10cm and -20cm, medium sand between -10cm and -40cm, and fine sand between -20cm and -100cm.

Compared to the sands, the inorganic amendments and peat contained significantly more water at saturation, > 55%, and released their water more gradually with increasing tensions up to -60cm. Once the bulk of water was released, the water content of the amendments leveled off and remained relatively constant for all four inorganic amendments out to the -15,000cm tension. Peat moss, on the other hand, had the most gradual release of any of the rootzone components at all tensions. This property was attributed to the wide distribution of pore sizes created by the fibrous particles of peat moss. For the sand/amendment mixtures, the water release curves were generally similar to the curves for each sand. The only difference was that amended sands retained slightly more

Table 3

Percentage loss of $\text{NH}_4\text{-N}$ and $\text{NO}_3\text{-N}$ in the effluent of sand amended at 20% by volume with four inorganic soil amendments and sphagnum peat moss

Soil Amendment	Form of Nitrogen in the Effluent	
	$\text{NH}_4\text{-N}$ Loss	$\text{NO}_3\text{-N}$ Loss
	----- Percent N Lost (%) -----	
Unamended Sand	96.2 a	98.1 a
Ecolite	7.8 e	99.2 a
Greenschoice	69.4 b	95.4 b
Isolite	63.9 b	97.8 ab
Profile	21.3 d	96.1 ab
Sphagnum Peat Moss	37.7 c	95.1 b
Means in the same column followed by the same letter are not significantly different under Fisher's protected LSD ($p = 0.05$)		

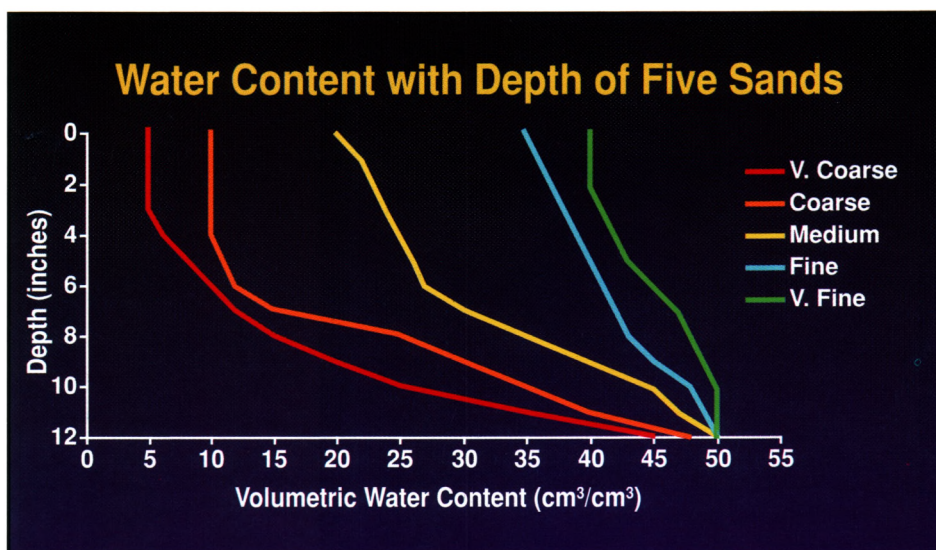
water than unamended sands at each tension (data not shown).

Water retained at theoretical wilt (-500cm) was greatest for the amendments, ranging 20% to 34% by volume, and least in unamended sands, 0.6% to 3%. Of all the rootzone components, available water was highest for the fine sand, 24%, whereas the other sands had less than 3% available water. This suggests that particle size and the architecture of adjacent particles when in contact, not a high degree of internal pore space, may be a more important determinant for available water.

Substantial data were generated on how the amendments responded in each different sized sand. However, for the sake of brevity, a general summary of the sand/amendment responses follows. Overall, amendments when mixed with the three sands had the most predictable response on porosity and water retention in the coarse sand and the least in fine sand. Fine sand and amended fine sand mixtures were the only rootzone mixtures that consistently met USGA guidelines for pore size distributions, 15% to 30% and 15% to 25% for air-filled porosity and capillary water retention, respectively (USGA, 1993).

The medium and coarse sand classes failed to meet specifications because they contained an excessive volume of air-filled pores, which would promote droughty conditions. The only exception was medium sand mixed with 20% peat, which also met guidelines. Although fine sand mixtures generally met specifications, not all fine sand mixtures met guidelines. Mixtures that failed were 10% and 20% peat or 20% Isolite and Profile amended sands. These mixtures were unsuitable because they retained too much water. Rootzones constructed with these mixtures may be undesirable because of excess soil wetness. This condition would probably contribute to poor turfgrass rooting, inadequate soil gas exchange, and problems with ball marking, footprinting, etc.

Bulk Density: As expected, amendment additions decreased bulk density for all three sand sizes, with peat-amended sands resulting in the lowest bulk density of all amendment mixtures. This result was anticipated because peat has the lowest particle density of the rootzone components. It is important to remember, though, that bulk density values alone generally are not an indicator of a successful rootzone mixture.



Selecting properly sized sand for constructing a putting green rootzone is the first step in providing the proper balance between rootzone moisture and aeration. Very fine sands are too wet throughout the entire rootzone depth. Very coarse sands are too dry and will require significant and potentially costly quantities of soil amendments to ensure they meet guidelines for putting green physical properties.

Percolation Rate: Saturated hydraulic conductivity, or percolation rates, were very high for all three sand sizes, > 35" per hour, and ranked in the following order: coarse > medium > fine sand. All sand mixtures had percolation rates that were much higher than the recommended 6" to 12" per hour, probably due to the highly uniform sands used. This observation is not unusual when working with very uniform sands (Bingaman and Kohnke, 1970).

Amendments generally decreased the percolation rate of the sands, but considerable variation occurred. The average percolation rates for each amendment across all three sand classes ranked in the following order: Greenschoice = Ecolite ≥ unamended sand ≥ Isolite ≥ Profile > peat moss. As expected, the 20% amendment rate significantly decreased percolation rates more than the 10% rate. It is important to note that no amendment or incorporation rate resulted in percolation rates falling below USGA guidelines.

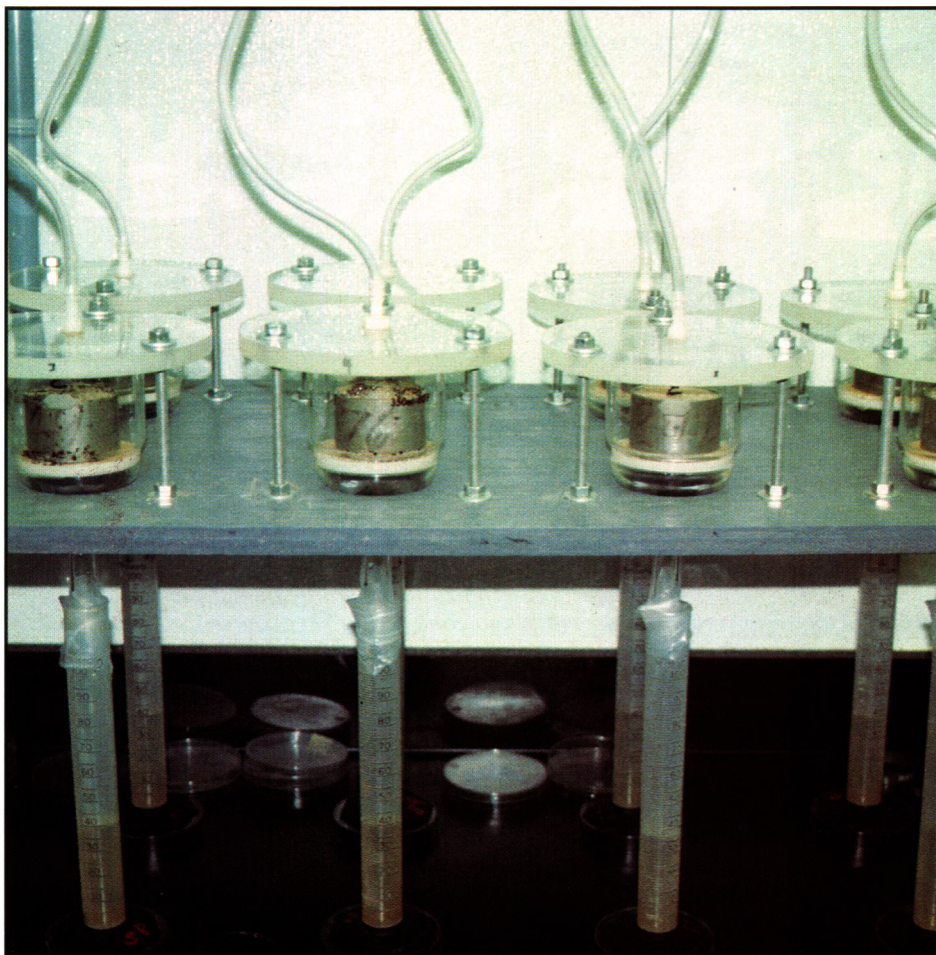
Nitrogen Leaching

Ammonium: Amendment additions significantly affected nitrogen leaching, most noticeably due to a wide range in ammonium ($\text{NH}_4^+\text{-N}$) leaching. Nitrogen appeared rapidly in the effluent of all rootzone mixtures, with peak concentrations around 70 ppm occurring near 0.5 pore volumes of leaching water. As expected, significantly higher peak $\text{NH}_4^+\text{-N}$ concentrations and more

cumulative $\text{NH}_4^+\text{-N}$ leached from unamended sand than from 20% (v:v) amended mixtures. Leaching decreased in the order of unamended sand > Greenschoice = Isolite > peat > Profile > Ecolite. The most effective amendments, Profile and Ecolite, decreased $\text{NH}_4^+\text{-N}$ leaching by 75% and 88%, respectively, compared to unamended sand. The effectiveness of these amendments for decreasing $\text{NH}_4^+\text{-N}$ leaching is directly related to their relatively high CEC compared to the other products.

A second study evaluating incorporation rates for Profile and Ecolite ranging from 1% to 20% by volume demonstrated that the loss of $\text{NH}_4^+\text{-N}$ and the peak concentrations decreased in a stepwise manner, as incorporation rate increased. The highest rate, 20% by volume, resulted in the least $\text{NH}_4^+\text{-N}$ lost for each of these amendments. This response is consistent with the results of MacKown and Tucker (1985), who reported decreasing $\text{NH}_4^+\text{-N}$ losses with increasing zeolite percentage in sand mixtures. In the present study, no difference in leaching between Ecolite and Profile were detected except at the 20% rate. At this rate, significantly less $\text{NH}_4^+\text{-N}$ leached for the Ecolite-amended sand. Although the 20% amendment rate was most effective, this quantity of product may not be economically practical when blending rootzone materials for green construction.

A third study determined the influence of amendment incorporation depth of 10% Ecolite and Profile, and



Rootzone components and sand amendment mixtures were analyzed for their ability to retain water using a water desorption technique in a constant temperature room.

demonstrated that incorporation depth significantly affected leaching. Even at a relatively shallow incorporation depth of 1", these amendments decreased cumulative $\text{NH}_4^+\text{-N}$ losses by almost 25%. Further, like the rate study, increasing the depth of the amendment resulted in a step-wise reduction of $\text{NH}_4^+\text{-N}$ leaching: Incorporation throughout the entire 12" deep rootzone resulted in the least $\text{NH}_4^+\text{-N}$ leaching.

Nitrate: Although Ecolite and Profile were effective at decreasing $\text{NH}_4^+\text{-N}$ leaching, they were without effect on nitrate ($\text{NO}_3^-\text{-N}$) leaching. For all rootzone mixtures, more than 90% of the applied nitrate was recovered in the leachate. In general, unamended sand and amended sand mixtures in all experiments were similar regarding high $\text{NO}_3^-\text{-N}$ leaching losses.

Turfgrass Establishment

Creeping bentgrass establishment on these sand rootzone mixtures was relatively slow, requiring > 250 days to reach 100% coverage. This response

may have been due to the somewhat droughty nature of this predominately medium-sized sand. This sand size was selected to best evaluate the water-holding benefits of the amendments tested. Although establishment was relatively slow, the significant effects and benefits of a rootzone amendment in this sand were obvious. Compared to unamended sand, bentgrass established faster on any of the amended sands. Rootzone mixtures ranked in order of increasing effectiveness were: unamended sand = Greenschoice < Profile = Ecolite < peat moss, with Greenschoice being similar to unamended sand on two rating dates.

The faster establishment of the amended sands is attributed directly to the greater water retention and, to a somewhat lesser degree, the increased nutrient retention compared to unamended sand. Although there was little difference in final establishment between sphagnum peat moss and the inorganic amendments Ecolite and Profile, there is a difference in cost between these materials. In most cases, inorganic amendments cost con-

siderably more than sphagnum peat moss when used at the same incorporate rate (Moore, 1999). This may explain the continued popularity of peat moss for amending sand-based rootzones.

Conclusion

Amending sand with inorganic amendments or peat moss had significant beneficial effects on rootzone mixture physical properties, nitrogen leaching, and creeping bentgrass establishment. **Although many of the inorganic amendments hold considerable water, it appears that if water retention and availability are important characteristics for a desirable rootzone mixture, then the most suitable amendment from both a quantitative physical analysis and an economic standpoint is peat moss.** This fact is particularly pertinent in coarse-textured sands, where a rather substantial quantity of the amendment would be required to effectively improve the water retention of these sands.

Furthermore, inorganic amendments vary in their ability to limit nitrogen losses. No amendment had a dramatic effect on $\text{NO}_3^-\text{-N}$ leaching. However, $\text{NH}_4^+\text{-N}$ leaching losses can be substantially decreased to 8% or less by various incorporation rates and depths of the clinoptilolite zeolite, Ecolite, and the porous ceramic, Profile, and to a lesser extent, sphagnum peat moss. Again, $\text{NO}_3^-\text{-N}$ leaching continues to be a concern in sand-based putting green media, particularly during turfgrass establishment when turfgrass root systems are small and when soluble fertilizers are used. However, it may be possible to minimize $\text{NO}_3^-\text{-N}$ leaching by constructing putting greens from sands amended with peat moss combined with either a zeolite or porous ceramic and using an $\text{NH}_4^+\text{-N}$ -based fertilizer program. The peat moss would be beneficial for the water-holding properties and the inorganic amendment would provide nutrient retention. The use of slow-release fertilizer products and the practice of spoon feeding greens during establishment are other proven methods to reduce nutrient leaching.

Lastly, it is important to remember that not all amendments are suitable for every rootzone amendment situation. Each amendment may react differently depending on the particle size range of the base sand used and the quantity of the amendment incorporated. Some sands may hold too much water and

others not enough. Therefore, it is extremely important to submit a potential sand and sand/amendment rootzone mixture to an accredited laboratory for physical analysis to determine if it meets specifications. Finally, although most of the amendments seem physically stable enough for modern putting greens, more research needs to be conducted to determine the long-term field performance before they can be widely prescribed.

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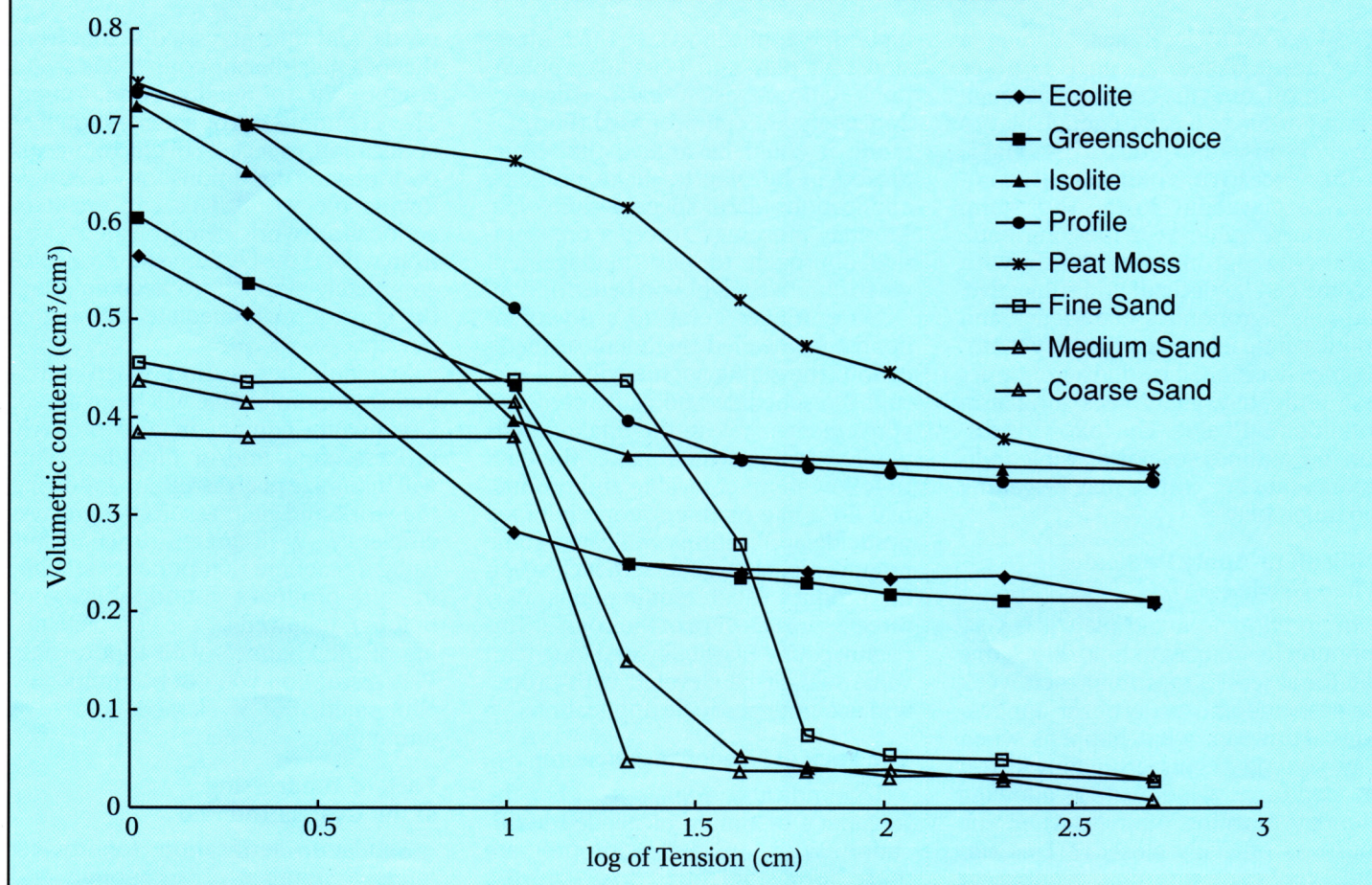
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Figure 1
Water release of three sand size classes and five amendments





Every golf course has a threshold level of play. When this threshold is exceeded, conditioning and maintenance fall off and costs go up. Identify the correct level of play volume for your golf course and protect that line.

HOW MUCH IS TOO MUCH?

Every course has a level of play that, when passed, results in conditioning/maintenance falling off and costs going up.

by **BOB BRAME**

PLAY VOLUME has become a major issue at golf courses throughout the country. Although it is important to receive enough play to cover expenses and return a reasonable profit, excessive volume will compromise playability in the short-term and course value over the long haul. Balancing agronomic health with income can be difficult and subjective. Although agronomics, economics, and politics are each a part of every maintenance decision, it is solid agronomics that ultimately guarantees long-term conditioning/value. The following discussion outlines several possible indicators that your course may be getting too much play.

Difficult to Apply Pesticides When Needed

In an effort to avoid play, it is very common for courses to hold/block one day (or at least a morning) each week for pesticide and/or fertilizer applications. However, what happens when play volume begins crunching in on the dedicated window (e.g. allowing Monday morning outings, when the course is officially closed)? This can force very early morning, evening, or

nighttime applications, or the concession that play and pesticide applications will co-exist. Clearly, efficiency and safety are compromised. Furthermore, it could be argued that being locked in by play to make pesticide applications at a specific time, like Monday mornings, forces a preventative approach to pest management when curative might be a better option.

No one likes going to a doctor or dentist for needed treatment or medication. Inevitably such a trip will disrupt the schedule and cause some inconvenience. Yet, in the final analysis you feel better, which makes the days to follow more enjoyable and productive. In a like manner, properly timed pesticide applications will cause some inconvenience to golfers. In fact, specific product label requirements may force a short closure of the course. Turf health, course playability, and long-term value will all be elevated with proper and accurate pesticide applications.

The Lack of Needed Aerification

This indicator applies to either the frequency or timing of needed aerification. While an aerification program must be custom fitted to a course's

needs, and thus may be different from that of a neighboring course, it is a vital component in quality conditioning. There continues to be a perception that aerification, especially of greens, means poor playing conditions for weeks following the work. This can result in aerification work being pushed away from what is the best time frame, or else completely skipped, to accommodate the short-term/immediate whining of players.

Schedule aerification when maximum agronomic value will be achieved. Use quality equipment and properly process cores and/or fill holes. This will minimize play disruption following the work and help assure the greatest efficiency. With greens, this means using a machine that punches straight in and produces round holes (not oblong), followed by the complete filling of the channels with topdressing. Play disruption will not be completely eliminated, but it can be held to a minimum.

Lack of Topdressing at the Correct Interval

Similar to aerification, topdressing offers a number of agronomic and

playability benefits. They include surface smoothing and firming, along with the enhancement of upper-profile porosity. The key to achieving these benefits is consistency. In fact, inconsistent surface topdressing can result in upper-profile layering that could compromise agronomic health and surface firmness/smoothness. In other words, it is better never to start a topdressing program than to start and then allow play volume to compromise the work.

Verify the appropriateness of your topdressing sand through the interaction of an accredited physical analysis laboratory and your Green Section agronomist. A program then can be customized to achieve the desired results. Generally, the target is to integrate sand into the surface in sync with growth. An appropriate operating budget and needed equipment should be aligned before starting. Time will need to be blocked each week for the work to be completed. Rain will occasionally force the work to be done the next day. Trying to maintain a consistent topdressing program with heavy play on the course is unrealistic and, in reality, will eventually fail. The short-term play disruption, in pursuit of the benefits a good topdressing program offers, will pay dividends over the long haul.



This player continues to enjoy the game even though the tees are being aerified. However, allowing play while aerification is in progress makes it more difficult for the staff to complete the work safely and efficiently.

Compromised Mowing

Heavy play that starts at or just after sunrise makes it difficult (if not impossible) to mow tees, greens, and/or fairways. Early morning shotgun starts further compromise needed maintenance

like mowing. Mowing at night or just before sunrise, in an effort to avoid play, often compromises quality and safety.

Although tees and fairways do not need daily mowing, greens do. Occasionally, triplex mowers are used on greens to help avoid inconveniencing the early players, even when the budget has adequate provisions for walk mowing. Walk-behind mowers offer a higher quality cut, a gentle smoothing/rolling action, and produce less stress on the turf. Clearly, this is a better option when the budget allows. Triplex mowing greens, when walk mowing is affordable, may indicate that maintenance is being compromised by play volume.

Heavy Divot Damage on Tees or Fairway Landing Zones

While usable square footage and design will impact divot damage, traffic volume must also be considered. Too much play on too small an area results in poor turf quality. In some cases it may be possible to enlarge tees, add tiers, or expand landing areas. Yet, wear-related traffic ought to bring up the question: Should the rounds per year be reduced?

There is a handy formula that helps correlate the interaction of available footage, play volume, and the resulting



Although it is important to receive enough play on the golf course to cover expenses, excessive play volume will compromise playability in the short term and impact course value over the long haul.

turf quality on tees: *You need 100 square feet of usable tee area for every 1,000 rounds of golf played each year. On par threes, the first and tenth holes, or any hole where irons are normally used, you need 200 square feet of usable tee area for every 1,000 rounds of golf played each year.*

The above guide should be applied to tee construction, enlargement, and/or the adding of tiers. Furthermore, although there is no precise formula for other areas, always consider the interaction of usable area, traffic, and turf quality — on all surfaces.

Wear Around Hole Locations or Greens Riddled with Ball Marks

This may suggest the need for more frequent hole moving, more consistent spoon-feeding, or cracking down on players who do not repair ball marks. Small greens with a lot of contour (thus, limited hole locations) clearly point to design limitations. Nevertheless, longer intervals between tee times, closing one day a week, eliminating play during the winter, or similar combinations to reduce play, may elevate conditioning and justify increasing fees, thereby offering similar, if not higher, income and better playing conditions.

Ornamental Plantings Used to Divert Attention from Poor Quality Turf

There is no question that well-placed and well-maintained ornamental plantings can add a great deal to course appearance. Unfortunately, regardless of how attractive they may be, ornamentals add very little, if anything, to playability. Improper aerification or inconsistent topdressing cannot be countered with ornamental plantings. In a like manner, being forced to triplex mow greens, as a result of heavy play, and then utilizing the staff on remote sites (predominately out of play) to maintain ornamental plantings is questionable prioritization and a clear indicator that play volume is compromising maintenance.

Weed Populations Are Steadily Increasing

The lack of weed control may well point to a maintenance program that is struggling to keep up with needed work. While weed control is a lower priority compared to needs like aerifying, topdressing, and/or pest control, the underlying message from a steadily increasing weed population may be too

much play for proper course maintenance.

Conclusion

Do not ignore the indicators that your course is receiving too much play. There may be other indicators specific to your course that could be added to those discussed. The bottom line is that proper agronomic conditioning of a golf course will cause occasional short-term disruption to play. Failing to acknowledge this fact and allowing play to dictate maintenance will cause deterioration in course value. Yet, the deterioration may be subtle and gradual, making it difficult to detect if candid objectivity is not guarded. Carefully identify the proper volume of play for your course and hold the line. Adjust play to needed maintenance work, not the other way around.

BOB BRAME is the Director of the North Central Region. While overseeing a nine-state area, Bob visits courses in Indiana, Kentucky, and Ohio. Heavy play and how to manage it are common discussion topics during on-site visits.



Too much play on too small of an area will result in poor turf quality. There is a direct relationship between usable footage, play volume, and turf quality.

The Birdies and The Bees

Native pollinators on your golf course.

by M. D. SHEPHERD
and V. J. TEPEDINO

NOTHING causes more excitement on a golf course than accomplishing the golfer's dream, a hole-in-one. But to other organisms, small and unobtrusive, scoring a hole-in-one is all in a day's work. We refer to bees, those uncommonly beneficial insects that collect food from flowers and deliver it, unerringly, to a hole in the ground or in wood, where it succors their offspring. We should welcome them to our golf courses, but not because we expect their hole-finding proficiency to rub off on us. No, we should do it to be good neighbors.

When you think of bees, chances are you think of those that live in hives or colonies like honeybees, or bumblebees, or of picnics disturbed by yellow jackets (which are wasps, not bees). Most people are surprised to discover that most of the more than four thousand species of native bees in the United States don't fit that description. Indeed, most bees are easily overlooked because they are solitary, not social, and most people never come into contact with them. Out of sight and out of mind, these bees play a vital role in renewing our environment by pollinating the majority of flowering plants; we can be good neighbors simply by providing them with habitat.

Pollination is one of the most important ecological services that animals perform for plants. It is a process that holds together the very fabric of our environment, those rich and diverse plant communities that clothe the soil and provide food for us and habitat for wildlife. Many different animals help with this: hummingbirds, bats, moths,



Sweat bees, like this Augochorella sp. halictid bee, are generalists, able to exploit a wide range of flowers and survive in degraded or weedy plant communities.

PHOTO BY EDWARD S. ROSS



The load of golden-yellow pollen collected by this leafcutter bee (Megachile sp.) can be clearly seen in its "pollen brush" on the underside of its abdomen.

PHOTO BY EDWARD S. ROSS

beetles, flies, wasps, and butterflies, but it is bees — especially native bees — that play a dominant role in plant reproduction.

For a process that is so important to us, pollination is sadly ignored, as are the creatures that provide this service. Research indicates that our native bees

are in decline, and in places suffering local extinction. The primary reason for this is the destruction, modification, and fragmentation of habitat. Urban growth and intensified agriculture and forestry have been significant causes of this. The habitat areas that remain are often isolated patches that have been



Encouraging pollinators on the golf course does not pose a risk to golfers, so nesting sites and plant materials can be placed close to the playing areas. Bee nesting blocks can be mounted on fences, placed in trees, or fixed to stakes in suitable areas (Wildhorse Golf Course, Mission, Oregon).

degraded by invasive plant species, pesticide use, and changes in land management. Fortunately, populations of many native bee species are quite resilient and even compatible with light or moderate human activity if supplied with a few necessary resources. We hope to illustrate here how some simple changes to out-of-play areas will benefit pollinators, help to beautify and naturalize your golf course, and make you a good neighbor to the surrounding community.

Life Cycle and Habitat of Native Bees

The native bees of North America range in length from less than an eighth of an inch to more than an inch. Their colors vary from nondescript brown or black to metallic green or blue, their markings from unmarked to bright red, white, or yellow stripes, and their hairiness from nearly bald (though most are quite hirsute) to profuse “punk” orange. Often their names reflect the way they build nests: plasterer bees,

leafcutter bees, mason bees, carder bees, digger bees, and carpenter bees. Others are named after particular habits, such as cuckoo bees that lay eggs in the nests of other bee species, or sweat bees that drink sweat from mammals.

Despite such diversity, they share two important characteristics: all are strict vegetarians that draw their sustenance from nectar and pollen, and they are quite placid, faster to flee than to sting. The solitary life led by most means they don’t have a colony to defend, and neither solitary nor social species are aggressive when visiting flowers. No special equipment or protective clothing is needed when working with native bees — unlike honeybees — and encouraging native bees on your course will not create any threat to golfers. You’ll have more problems from yellow jackets attracted to trash cans than you’ll ever have from these gentle pollinators.

Solitary bee females perform a multitude of duties and do so unassisted by

workers or drones. Females mate soon after emerging as adults and then spend the rest of their brief, three- to four-week lives searching for, selecting, and sometimes excavating their own burrows, preparing their nesting tunnels to receive the pollen and nectar they will collect, and laying eggs. A few bee species excavate their nests within the soft central pith of stems and twigs, but many more use abandoned beetle burrows in dead snags. Others dig a nest in bare or sparsely vegetated soil. The nests of some species will have only one cell, but most will have many. These cells are often in a line filling the hole or burrow, but some are in complex, multi-chambered tunnels.

A source of nectar and pollen is essential for bees. Adults of both sexes feed on nectar and sometimes pollen, commonly visiting hundreds of flowers on a foraging trip. Females also collect both nectar and pollen as food for their offspring. This pollen is taken to the nest securely carried in either a “pollen brush” on the underside of the

abdomen or in "pollen baskets" on the hind legs, depending on species. During foraging, other pollen grains get caught in the bee's body hairs and are deposited on the stigmas of subsequently visited flowers. Thus, almost by accident, bees perform one of the fundamental relationships that keep ecosystems healthy.

During their active life, bees will not collect pollen and nectar from all the plant species that are in bloom, but different bee species will differ greatly in the number of plants they are attracted to and can exploit. Some bee species can be defined as generalists, i.e., they are visitors to a large proportion of the flower species available, and others as specialists, because they visit only a narrow, usually closely related, range of plant species.

A Conservation Partnership

In the summer of 1997, the Xerces Society (Portland, Oregon), with the help of the USDA Bee Biology and Systematics Lab (Logan, Utah), initiated a project to explore methods to enrich out-of-play areas of golf courses with native plants for pollinator insects. The project was funded by a grant from the Wildlife Links Program of the USGA and the National Fish and Wildlife Foundation. Project staff worked with the superintendents at three golf courses in the Columbia Basin of eastern Oregon and Washington. The three courses were Wildhorse in Mission, Oregon; Veterans Memorial in Walla Walla, Washington; and Horn Rapids in Richland, Washington. For each golf course, a reference site was also established in a nearby area of natural vegetation so that pollinator populations could be compared.

The project had four main components. These were to:

1. Survey and compare pollinating insects among golf courses, and between golf courses and their respective "natural" areas.
2. Enrich out-of-play and rough areas of golf courses with flowering plants native to the locality.
3. Create pollinator nesting sites.
4. Educate people about the importance of pollinators and their management.

Surveys trapped over 10,000 individual bees and showed that 78 bee species, representing 25 genera, used the courses, perhaps mostly as flyways. This is an important finding because it demonstrates that large numbers of pollinators are associated with some

golf courses, and that golf courses can serve as refuges if we can supply the necessary resources. At the same time, it is equally important to recognize that, though abundant, the existing golf course pollinator fauna is impoverished in that it is dominated by only three genera of sweat bees (*Agapostemon*, *Halictus*, and *Dialictus*). In 1997, these three genera accounted for 92 percent of specimens captured.

This pattern of species abundance causes concern. The three dominant genera are generalist sweat bees that are frequently associated with disturbed and degraded plant communities composed of weedy species. Sweat bees are

managing habitat areas for vertebrates, for some plant communities, and for wetlands, including the Landscape Restoration Handbook produced by the USGA. Recommendations for pollinator conservation management, however, are not readily available. In this section we describe methods for attracting a variety of native bees to golf courses, and for supplying them with the pollen and nectar they need to survive and reproduce once they get there.

Introducing or restoring local species of native flowering plants is the first step to converting a portion of your golf course to a pollinator refuge. There are



Matthew Shepherd checks one of the bee nesting boxes at Wildhorse Golf Course (Mission, Oregon). The holes with plugs have been filled with egg cells and sealed with mud.

able to visit and exploit the flowers of a wide variety of plants. However, because of their very diverse tastes in flowers and their habit of moving almost randomly among several plant species on a single foraging trip, they are usually regarded as inferior pollinators when compared to other, more specialized species. In contrast to these generalists, specialist species restricted to foraging on a few species of flowers are more vulnerable to changes in numbers of their preferred species of nectar and pollen plants. Unfortunately, specialist pollinator populations appear to be quite low or non-existent on golf courses in this part of the Northwest.

Enhancing Foraging Areas

There are many good sources of information on planning, creating, and

several reasons for this. As already noted, native species are adapted to the area's climate, and once established, should require minimum attention. In contrast, horticultural varieties and hybrids of many plants are not necessarily well adapted to local climates. In addition, they have been artificially bred to produce showy blooms at the expense of pollen and nectar production. Unlike such ornamentals, native plants have supplied native bees with pollen and nectar for ages and are well adapted to do so.

Plants should be chosen with diversity of both shape and color and of blooming periods in mind. Diversity is important because, as noted earlier, many bee species either prefer, or are obligately dependent on, particular kinds of flowers for food. In general, the more kinds of flowers planted on

the course, the more kinds of bees that will be supported. Color and scent are significant to attract bees; they are particularly attracted to blues, violets, yellows, and whites. Equally important is selecting species in a range of flower sizes and shapes, as there is a rough association between the depth of the flower tube and the length of the mouthparts of the bees that use them. Thus, the more different depths represented, the more species of bees attracted. Variety of flower shape and symmetry (radial vs. bilateral) will also help to favor a variety of bees.

Another consideration when choosing plants is the blooming time and duration. The flowering time of many plants is restricted, sensitive to the

amount of daylight, and thus predictable. It is easy to select a range of species that will, together, fill in the growing season with a diversity of flowers through spring, summer, and fall. Such a planting strategy will support a diversity of bee species, catering to species that fly only in spring, summer, or fall and those that are active for longer. A variety of flowers through the year will make the habitat more attractive to golfers as well.

In an article of this length it is not possible to list specific species of plants for every region. Table 1 lists plant genera that are good nectar or pollen sources for the semi-arid Columbia Basin. They are listed here only as examples because all planting decisions

must be made with the local flora in mind. Talk to native plant nurseries, your local native plant society chapter, other wildlife organizations, or consultants in your local area to refine this list with suggestions for equivalent local species of these or other plants, information on flowering times, and advice on what is best adapted to local conditions. The Lady Bird Johnson Wildflower Center in Austin, Texas, offers lists of species suitable for many local areas.

For most situations pot-grown transplants are preferable to seed for establishing the plants. Transplants are more likely to survive when introduced to existing grassy areas. Ideally, the plants you use should be from a local supply of seed or cuttings. Local plants are likely to be better adapted to growing conditions and climate and should be easier to establish and grow. They are also more likely to be attractive to local native bees.

There are several things to consider then locating habitat. Bees are unusual among insects because of their high level of parental behavior. Their need to supply food for their offspring makes them density-sensitive foragers. Thus, while any flowering habitat is good, bigger patches can hold more plants and will be more attractive to bees. Try to avoid long, narrow patches, as the centers of these will be disturbed more by activity on the edges (like mowing or maintenance work) than larger, blocky areas. Where possible, link new areas or add onto existing habitat as this will generate greater benefit for the same amount of effort.

Bee Nesting Sites

The second major requirement of native bees that pollinator conservationists must supply is suitable nesting habitat. As with flowering plants, the more kinds of nesting places that are made available, the more types of bees one can expect to attract. Many, though not all, easily creatable types of nesting sites will be suitable for your course. For example, unsheltered adobe blocks may not last long in a rainy climate, and sand pits and piles may be superfluous on sandy sites.

Outlined below are eight ways to make nesting sites, four each for ground-nesting and snag-nesting bees. In all cases, location of the nesting sites is important. Wet soil is usually bad for ground-nesting bees and should be avoided. Choose sunny, dry, well-drained areas for the bare-ground and

Table 1
Native Plants for Nectar and Pollen

These plants were chosen for the sites in the semi-arid Columbia Basin where the Wildlife Links project worked. They are listed as guidance. Talk to native plant nurseries in your local area to identify equivalent species for your region.

Family	Genus	English name
Salicaceae	<i>Salix</i>	willow
Polygonaceae	<i>Eriogonum</i>	buckwheat
Berberidaceae	<i>Berberis</i>	Oregon grape
Crassulaceae	<i>Sedum</i>	stonecrop
Grossulariaceae	<i>Ribes</i>	current, gooseberry
Rosaceae	<i>Geum</i> <i>Rosa</i>	avens wild rose
Leguminosae	<i>Lupinus</i>	lupine
Geraniaceae	<i>Geranium</i>	geranium
Linaceae	<i>Linum</i>	flax
Malvaceae	<i>Sphaeralcea</i>	globe-mallow
Cactaceae	<i>Opuntia</i>	cholla, prickly pear
Onagraceae	<i>Clarkia</i> <i>Oenothera</i>	clarkia evening primrose
Umbelliferae	<i>Lomatium</i>	lomatium
Primulaceae	<i>Dodecatheon</i>	shooting star
Polemoniaceae	<i>Gilia</i>	gilia
Hydrophyllaceae	<i>Phacelia</i>	phacelia
Labiatae	<i>Agastache</i> <i>Scutellaria</i>	giant hyssop skullcap
Scrophulariaceae	<i>Penstemon</i> <i>Verbascum</i>	penstemon mullein
Caprifoliaceae	<i>Symphoricarpos</i>	snowberry
Compositae	<i>Achillea</i> <i>Aster</i> <i>Chrysothamnus</i> <i>Gaillardia</i> <i>Helianthus</i> <i>Senecio</i> <i>Solidago</i>	yarrow aster rabbit brush blanket flower sunflower groundsel goldenrod
Liliaceae	<i>Alium</i> <i>Brodiaea</i>	wild onion brodiaea



Bee nesting boxes can be made from blocks of water-resistant lumber, drilled with various sized holes. These boxes provide a suitable nesting habitat for solitary nesting bees (Veterans Memorial Golf Course, Walla Walla, Washington).

sand-pit techniques. The techniques to create wood substrate nests can be more widely used as they are less affected by ground conditions. Try to place these nests so that they are sheltered from the worst of the weather yet receive direct sunshine early in the day. Facing the entrance of such nests east or southeast is best because bees like warm conditions, especially in the morning so they can become active earlier.

- **Bare ground.** Simply clear the vegetation from a small level or gently sloping area (about 6' by 6') and compact the soil. A few rocks placed in the cleared area will improve it by adding basking places and help to warm the soil. Bare areas on precipitous, south-facing slopes or banks will draw other species.

- **Adobe blocks.** Use adobe blocks to construct a wall about 4'-5' high and 5'-6' long. Use wood and/or metal backing and supports to prevent toppling. Drill holes ($\frac{3}{32}$ " to $\frac{3}{8}$ " in diameter) into the blocks at least 4" deep.

- **Sand pits.** Dig a pit about 12' square and 4' deep, and fill it with fine-grained, pale-colored sand.

- **Sand piles.** Create a sand pile of a similar size and materials as the sand pit.

- **Logs and snags.** Get some logs or old stumps and place them in the

habitat patches. Plant a few upright like dead trees to ensure some deadwood habitat stays dry. Drill holes as in the adobe blocks.

- **Elderberry bundles.** Cut elderberry stems into lengths of 8" to 12". Drill out the central pith to form a hole $\frac{3}{32}$ " to $\frac{3}{8}$ " in diameter to a depth of 6" (do not drill completely through the stem), and then tie the stems in bundles of 15 to 20. Fix the bundle to a stake or tree with the stems horizontal to the ground. (Other stems with soft pith can be substituted, such as blackberry, raspberry, or sumac.)

- **Elderberry stakes.** Cut stakes from elderberry stems about 24" to 30" long. Drill out the pith from one end as you did the stems for the bundles, and then about 12" from the end, drill a "side hole" of similar diameter through the bark just into the pith. Drive them about 6" into the ground.

- **Nesting blocks.** Bee nesting blocks can be made from blocks of water-resistant lumber at least 4" by 4" and 8" long. (Redwood or cedar are good choices, but any treated wood, preferably aged, will do.) In one side of the block, drill lots of holes $\frac{3}{32}$ " to $\frac{3}{8}$ " in diameter and almost all the way through the block. When drilling, make the interior of the holes as smooth as possible. Bees are not partial to rough-

ened holes and may avoid them. Ideally, the top of the block should slope slightly towards the entrance and be capped with a plywood roof (like a bird nesting house). The roof should extend beyond the front of the block to afford the nesting holes some protection from precipitation. This block can be fixed to a stake or tree in a sunny, preferably eastward-facing spot.

Helping the Forgotten Pollinators

Golf courses have a huge potential to contribute to the well-being and education of the public, and to greatly benefit local wildlife by providing safe refuge as the landscapes around them come under increasing pressure. Conservation of native bees and plants is a valuable way in which golf courses can contribute to a healthier environment and is a comparatively simple task to integrate into the management of a golf course. The simple actions that can be taken to conserve native bees targets two key aspects of their habitat: foraging areas and nesting sites. Habitat diversification inevitably benefits other wildlife as well — a more diverse environment results in a more diverse range of inhabitants — and, since the habitat will support populations of helpful predators, can assist in pest management.

Every superintendent who can find space on his or her course has the potential to improve both the pollinator populations in the local area as well as the image of the course itself, both aesthetically and to the local community. Golf courses can be good neighbors to the flower and vegetable gardeners of their immediate areas, to the school systems who will use them for education, to the golfers who can appreciate the native vegetation, and, of course, to the creatures who will find a home there. Golf courses can make a difference across the nation, forming a network of enhanced pollinator habitat to support the vital work of native bees in the health of both farmland and wildlands.

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VINCE TEPEDINO, Ph.D., is a research entomologist with the USDA-ARS Bee Biology and Systematics Laboratory at Utah State University in Logan, Utah.

GAINING A NEW PERSPECTIVE

Enhancing pond shorelines with native aquatic plants.

by STEVEN VISOSKY

IN THE LAST several years, aquatic and shoreline plants have become an accepted and even desirable alternative to manicured pond edges on golf courses. Though new golf courses have an opportunity to create naturalized water features during construction, existing facilities are faced with retrofitting to achieve the benefits that aquatic plants bring to the golf setting. At Cordillera Resort's Mountain Course in Edwards, Colorado, that's just what we did — and we've been very pleased with the results.

The Setting

Hole #16 at Cordillera Mountain Course is a beautiful par five with a 1.5-acre lake near the tee. When the course first opened in July 1994, bluegrass was sodded to the water's edge. There were three full-circle heads that watered this area, but unfortunately, they watered the lake as well. In 1997, we decided that a more natural look would provide an attractive landscape feature that would also promote habitat for ducks and other wildlife.

One Step at a Time

A project of this magnitude requires careful planning and execution. To start, we outlined several goals to help direct our efforts. First, we wanted to increase wetland wildlife habitat while enhancing the aesthetics of the lakefront. Thus we chose a variety of native Colorado plants that would add color and provide food and cover for wildlife. Equally important, we wanted to reduce water waste by moving the irrigation heads and only throwing water towards the beds and turf.

The next step in our project was to hire a local environmental consultant, Montane Environmental Solutions, Ltd., to help with plant selection. They provided an extensive list of appropriate shrubs, wetland plants, border perennials, and wildflowers.

To prepare the site, we removed a 4-foot strip of bluegrass along the lake and moved and adjusted the three problem irrigation heads so that they would no longer water the lake. The



Natural landscaping along the lake bank on hole #16 at the Cordillera Mountain Course (Edwards, Colorado) provides an attractive water feature that promotes habitat for ducks and other wildlife.

area was rototilled and planted with many different varieties of plants. Cat-tails (*Typha* sp.), three square bulrush (*Scirpus americanus*), hairy sedge (*Carex lanuginosa*), and torrey rush (*Juncus torreyi*) were among the wetland plants chosen to provide duck habitat. More than 50 native perennials and wildflowers, including pink yarrow (*Achillea millefolium*), Rocky Mountain columbine (*Aquilegia caerulea*), asters (*Aster* spp.), and scarlet gilia (*Ipomopsis aggregata*), create a mosaic of color that lasts throughout the growing season.

Maintaining the new plantings requires hand pulling weeds from the beds, mulching when needed, and replacing plants that do not make it through the winter. Because we are especially careful about avoiding chemical applications in the buffer zone near the lake, our labor needs have increased by three or four man-hours per week in this area.

Results

We have been very pleased with our results, and in fact we have met all of our goals. We gained a three- to four-foot buffer of native Colorado plants that provides wildlife habitat, improves

aesthetics, protects water quality, and eliminates water waste.

For the first time, we had two pairs of ducks use the lake for nesting in 1998 and 1999. We also have seen an increase in the number of ducks just using the lake for everyday feeding and resting.

We've had a great response from golfers and members, too. Our green committee has been highly complimentary and is considering aquatic landscaping for another lake on the property.

We also have reduced the amount of water used in this area by 50%. By changing just three irrigation heads, we save approximately 35,000 gallons of water during our growing season from May to September.

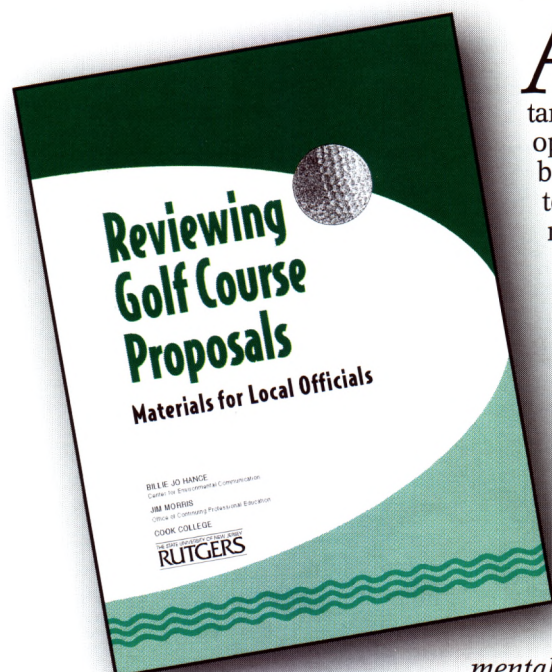
Perspectives

In retrospect, it would have been a lot easier to do this project before they laid the sod. If you are involved in new golf course construction or pond construction or renovation, I would definitely recommend landscaping with aquatic and shoreline plants, rather than turfgrass, from the outset.

If your only choice is to retrofit, it's still worth it. Native aquatic plantings can be a wonderful resource if you have shoreline at your facility that is not directly in play, yet is in a visible area. Research is very important in determining which plants are most suitable for your area, and a local consultant may prove to be helpful. Discuss with your golfers the benefits of enhancing wildlife habitat along with improving the aesthetics of your shoreline. The results can be rewarding for both golfers and wildlife.

STEVEN VISOSKY is the golf course superintendent at the Cordillera Mountain Course, an 18-hole resort guest and semi-private golf course in Edwards, Colorado. Cordillera Mountain Course achieved designation as a **Certified Audubon Cooperative Sanctuary** in January 2000. Cordillera Resort's Short Course and Valley Club are also registered members of the Audubon Cooperative Sanctuary Program for Golf Courses.

New Publications Available



ACROSS THE COUNTRY, community planners and golf course developers are making important decisions about how to build and operate golf courses that can both benefit local communities and protect and enhance the local environment. As a product of a USGA education grant, the Rutgers University Center for Environmental Communication has produced an information packet entitled **Reviewing Golf Course Proposals**, which is oriented to community land use planners to assist communities in the crucial planning phase of golf course development.

Included in the easy-to-use packet are:

- *Reviewing Golf Course Proposals: Ten Environmental Issues to Consider*, a brochure outlining the bottom-line environmental questions communities should ask when reviewing golf course proposals.
- *Environmental Principles for Golf Courses in the United States*, guidelines developed by Golf & the Environment, a committee of golf, environmental, and government representatives.
- Supplemental materials and case studies providing more in-depth information for each of the ten issues.
- Selected golf course planning websites and publications.

The packet is available for \$5.00, plus shipping and handling, through the USGA Order Department at 1-800-336-4446.

THE GREEN SECTION has updated and released the popular publication *The Green Committee Guide*. This publication, available for \$2.00 each through the USGA Order Department, is designed to help guide Green Committees past the common pitfalls, show the opportunities of participating in the Green Committee, and assist in making the Committee work as an asset to the golf course. In addition, the book highlights the features of the Green Section, defines common agronomic terminology, and provides a list of references and resources for additional information.



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.

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Attn: Mark Flock
(419) 753-2448 • (419) 753-2949 FAX

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Unit 58, Stirling Enterprise Park
Stirling FK7 7RP 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

ISTRC NEW MIX LAB, LLC

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Olathe, KS 66061
Attn: Bob Oppold
(800) 362-8873 • (913) 829-8873
(913) 829-4013 FAX
e-mail: istrNewMixLab@worldnet.att.net

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Attn: Michael S. Hindahl, Ph.D.
(503) 630-7769

THOMAS TURF SERVICES, INC.

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College Station, TX 77840-5247
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Olathe, KS 66062
Attn: Chuck Dixon
(913) 780-6725 • (913) 780-6759 FAX

*Revised July 2000. Please contact the USGA Green Section (908-234-2300) for an updated list of accredited laboratories.

SAY NO TO “BACKDROPS”

by DAVID A. OATIS

Golfers have come to believe that every golf hole must have a backdrop of trees, but many holes would be better off without them!



This gallery of shrubs creates an unnecessary backdrop to the green. Dense backdrops result in a variety of problems for greens — both agronomically and in playability.

FOR THOSE OF YOU who are regular readers of the *Green Section Record*, you may recall an opinion article of a similar title that appeared in the magazine some three years ago. “Say No to Memorial Trees” was the title and it generated a wide range of responses and discussion. Some of the responders applauded the message, while others were horrified. This is the second in an ongoing series and should elicit similar responses.

When polled some ten years ago, the *Green Section* staff overwhelmingly elected trees as the single biggest problem of turfgrass management on golf courses. If polled again today, the answer would remain unchanged. Trees add a great deal to our golf courses, but they also can create a host of problems, related both to agronomics and playability. Now there are many good reasons for planting trees, and improving safety may be the single best reason. However, there are an even greater number of poor reasons for planting trees, and the idea of creating a backdrop is one of the most common.

For reasons unknown to this author, the notion that “every green must have a backdrop” has in recent years become a pervasive belief. This belief holds that behind every green there must exist dense plantings of trees, shrubs, or other vegetation, and nothing should be visible behind the green save this “green wall.” As a result of this commonly held belief, the areas around

many greens have been grossly overplanted, and this has been to the detriment of the turfgrass, golf course maintenance budgets, and even to the beauty and architecture of many golf holes. An overabundance of trees can make it more expensive, and perhaps physically impossible, to grow healthy turfgrass. The playability problems caused by the plantings also can be severe, and balls narrowly missing the target may wind up lost or unplayable. Excessive planting also can be detrimental from an aesthetic standpoint, as it can obscure lovely views and create a more closed-in or even a claustrophobic environment. The unnecessary vegetation may block a view of the golf hole from the teeing ground or the landing area of the fairway. The original architecture of the hole can be lost, and the basic question of “why do we need backdrops?” begs asking.

Harkening back to the early days of golf, keep in mind that judging yardage was considered a skill and was an integral part of the game. There were no yardage aids in those days, and greens were purposely built without backdrops to provide greater challenge in judging distances. With the advent (read *proliferation*) of yardage aids, judging distance has virtually become unnecessary. It is a forgotten skill. If ever there were a need for backdrops, it has been eliminated with the advent of yardage aids.

From the aesthetic sense, dense backdrops greatly alter the look of a hole, and this can affect golfer perception. In the case of a green that is perched on a hill and surrounded with steep slopes, vegetative backdrops only serve to hide the defense features, which are the steep slopes. This can make the hole appear easier and more approachable than it actually is. The noted architect Allistair Mackenzie once said that a hole should look tougher than it plays. Backdrops often cause the opposite. Many of the older courses I have visited over the years once had spectacular views from various areas of their property. Trees and brush grow slowly, and 20 or 30 years of neglect can gradually obscure views that once were an integral and much-loved part of a golf hole. This happens so slowly that it can go virtually unnoticed.

There is much to be said for a green that appears perched atop a precipice. Hitting a shot to a green that has no visible bail-out area and with only nothingness behind it causes golfers’ thoughts to give way to doubt and mistrust. A green that appears unassailable just might be! Keeping greens open and exposed will allow for improved turfgrass health and more interesting golf. If you have backdrops behind your greens, take a look at the turf and see if it is suffering. Take a look behind the green and see what the vegetation is hiding. You might just be surprised to find that you have weak turf and have lost a magnificent view. If you are fortunate, you may also discover a fine, stand-alone specimen tree in hiding.

Undeniably, there are situations where dense plantings are desirable and perhaps even necessary for safety. Blocking out unattractive vistas clearly makes good sense, as long as turfgrass health is not compromised. However, more often than not, your best course of action is to “Say No To Backdrops!”

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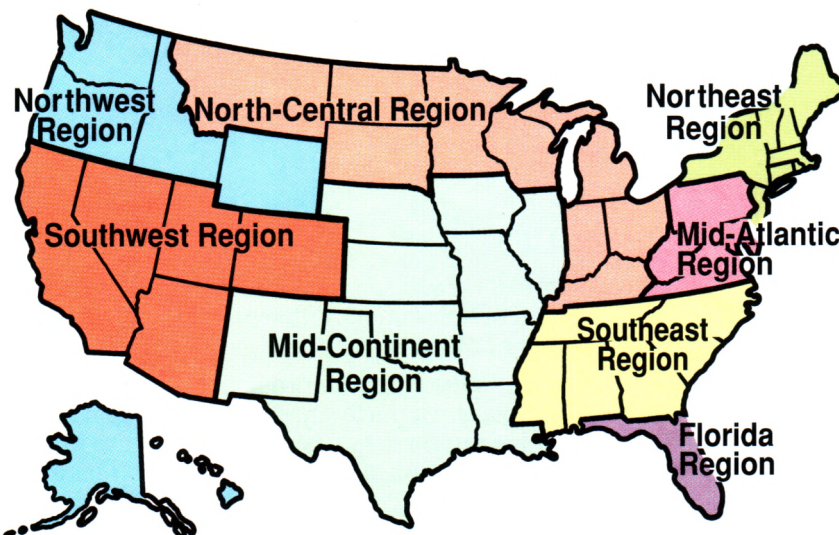
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TURF TWISTERS

GOOD TECHNIQUES

Question: I have a problem. Each summer the #1 blemish I have on my putting greens is scalped plugs. I have tried everything — different hole cutters, different hole changing techniques; nothing seems to solve the problem completely. Any thoughts? (Virginia)

Answer: One of the most common problems USGA agronomists see is high and low hole plugs. It is a common problem that golf course superintendents seem to solve, to the extent they can, in different ways. The most common solution is to develop the expertise of the individual changing the holes. It is an art, no matter what hole changing technique is utilized. It takes time to properly change a hole. Delegate the job to one of your best employees, preferably one who also plays golf. Do not have different people do this important chore just because they are available. Walk your greens, and if you see high or low plugs, send that one individual back out to level them up. We will wager that after a few trips around the golf course rechanging holes, especially on a hot afternoon, extra care will be exercised to do the job right the first time.

SOLVE PROBLEMS WITH

Question: What is the best way to store expensive bentgrass seed? (Georgia)

Answer: The key concept for seed storage is to keep the combination of temperature and humidity, when added together, below 100. Obviously, this is not easy to accomplish anywhere. Ideally, store your expensive bentgrass seed in a cooler or freezer. This not only keeps the seed viable, but also solves the usual mouse problems.

DRAINAGE ISSUES

Question: When is the best time of year to install fairway drainage? (Utah)

Answer: Although the wet areas should be mapped in winter, actual installation should take place in summer. Installing drainage during the dry summer months is faster, results in less damage to the golf course, and reduces the time it takes for the trenches to heal over.

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