Cardinal Rules

A list to live by – from A to Z

Editor's note: With a little help from his friends (about 30 of his peers), Lee Griffin, assistant superintendent at the Country Club of Johnston County in Smithfield, N.C., created this A to Z list that superintendents should strive to adhere to in their work and daily lives.

A — **Attitude** determines altitude.

B — **Big Picture**. Always see it and take it in at all times. This allows you to better perform the many tasks you face daily.

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C — **Communicate**, communicate, communicate. You can never overcommunicate to your employees, golfers or employers.

D — **Duck** … when someone yells, "Fore!

E — **Employees**. Always hire the best, pay them fairly and treat them well.

F — **Family**. You married your wife, not your course.

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Caretakers of the Game

- Steven W. Renzetti
CGCS
Quaker Ridge G.C.
Consulting Agronomist, LPGA Tour

In the history of golf course maintenance, several significant developments have altered either the way we perform our jobs or have raised the bar on course conditioning. I believe that no event has had a more direct impact on putting green quality than the mass conversion from metal spikes to plastic cleats.

"...no event has had a more direct impact on putting green quality... than the mass conversion from metal spikes to plastic cleats."

Golf course superintendents were the most passionate among those groups that initially embraced the use of plastic cleats over metal spikes. On the surface, we saw the benefits of better looking greens and healthier plants. Once golfers could see the incredible changes that alternative cleats brought to the game, they joined superintendents in supporting this major makeover.

Over the past decade, golfers have benefited from vast improvments in ball and club technology. The game is different because of them. But golfers, and we as superintendents, are acutely aware of the incredible gains brought to the game from the advent of plastic cleats.

Cardinal Rules

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G — God. After all, we're taking care of His creation.

H — Honesty. It's always the best policy in any situation.

I — It. It's only grass, and it will usually grow back.

J — Job. Do your best at your job, but remember — it's just a job.

K — Know. Don't be afraid to say, "I don't know." It's not your job to know everything but to know someone who does know an answer.

L — Listening. God gave us two ears and one mouth. That should be a hint.

M — Mountain. Is this the mountain you're willing to die on? Too often, we make too much of the little things and fight for something that's trivial.

MIKE KLEMME

N — Never. Never think that you can't improve.

O — Organization. This is vital in presentation. How you keep your shop and your personal belongings in order says a great deal about the kind of person you are. Plus, you'll be able to find what you need when you need it.

P — Politics. Try hard not to get involved with politics.

Q — Quiet. "At times, it's far better to remain silent and be thought a fool, than to speak up and remove all doubt," Abraham Lincoln said.

R — Records. You can never keep enough records — pesticide, financial, employee, work, weather, etc.

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S — Sod. Green side up.

T — Treat. Treat others the way you want to be treated.

U — Unity. Promote unity with the pro, general manager, green chairman and other golf course staff members.

V — Visible. Be visible to employees, golfers, media and employers.

W — Walk. Walk your greens daily and your course weekly.

X— Xample. Lead by example.

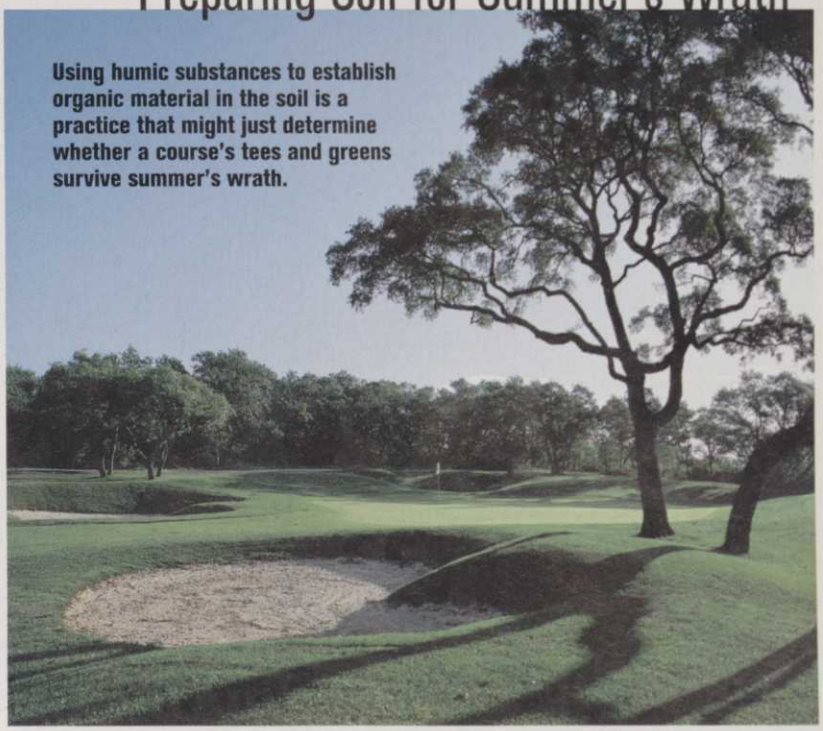
Y — You. You can make a difference. You have the same 24 hours in a day that Helen Keller, Albert Einstein, Franklin D. Roosevelt and Donald Ross had.

Z — Zest. Have a zest for life and your job. ■

If you'd like to add to the list, we'd love to hear from you. You can e-mail your responses to laylward@advanstar.com or fandorka@advanstar.com

Tips

Preparing Soil for Summer's Wrath



Using humic substances to establish organic material in the soil is a practice that might just determine whether a course's tees and greens survive summer's wrath.

Humic substances improve root system

BY KEVIN HATTORI

"Readiness is all." (William Shakespeare, poet and playwright)

"Be prepared." (Lord Baden-Powell, founder of the worldwide Scouting movement)

Shakespeare and Baden-Powell might have made good superintendents. After all, most superintendents would agree that being ready and prepared is better than reacting to crises.

Summer's stresses will make their annual appearance at some point this year, and superintendents who are prepared for their onset will fare better than ones who are not. With many areas of the country already facing drought, many superintendents are casting a wary eye towards June, July, August and beyond.

Fortunately, there are ways to get turfgrass ready for what is on the horizon. Since the foundation you lay for your turf determines how it responds later, it is critical to take the right steps now to build a strong one.

The goal of any nutrition program should be to create the healthiest possible environment for turf. Using humic substances to establish organic material in the soil is a practice that might just determine whether a course's tees and greens survive summer's wrath.

Using moderately heavy rates of a

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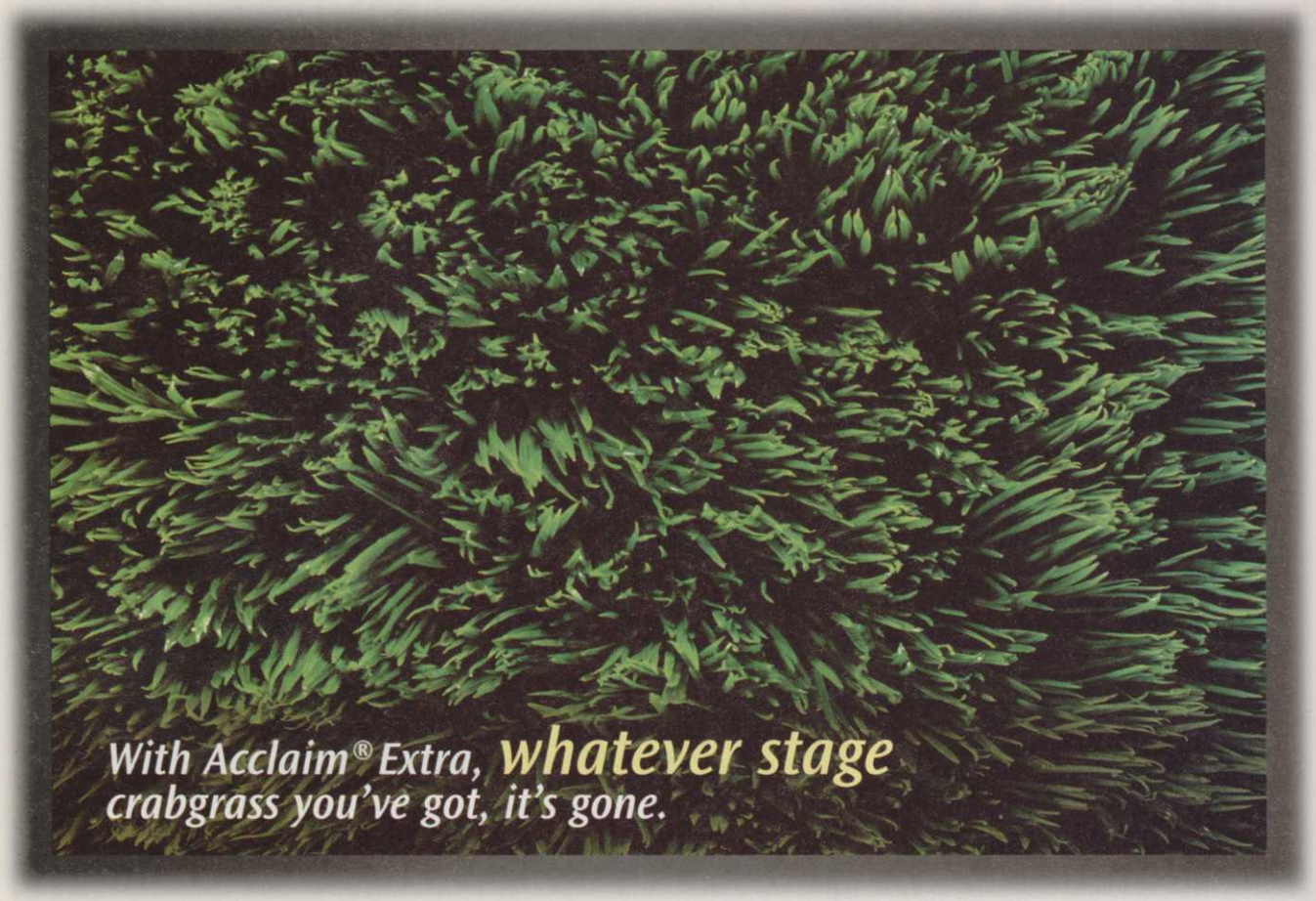

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* based on a recommended retail price per gallon.

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Continued on page 83

good organic soil amendment and a biostimulant will provide a suitable, clean soil structure in which turf can grow. Humic substances improve older, push-up greens and tees by increasing the soil's water holding capacity and its ability to resist compaction during a drought. Humus actually alters and rearranges soil platelets to increase air and water penetration.

In addition to re-establishing always-important organic materials in the soil, humus increases cation and anion exchange characteristics, processes that flush out excess chemical salts in the soil. This is especially important since these salts, which come from multiple sources (poor quality water, pesticides and synthetic fertilizers), can cause phytotoxicity, especially during hot summer months.

Adding organic materials to poor soils will improve both soil health and plant quality.

On the other end of the spectrum, sand tees and greens are notorious for their inability to hold water, especially near the surface, where the rate of evaporation is high. Humic substances are valuable for combating this phenomenon, since they encourage deeper rooting and increased root-mass development. This is especially important when the summer months arrive, as existing root masses actually decrease during times of heat and drought stress. In short, the root system your turf develops prior to the summer will greatly determine its ability to survive. A healthier root system also provides better development and improved overall plant vitality.

Applications of organic substances will also help the existing beneficial microbes in the soil. Good organic materials supplement the soil, in turn providing a food source for beneficial microbes and supplying them with the nutrients they need to survive and flourish. Clusters of organic material actually encourage the growth of beneficial microorganism colonies, which compete with fungal diseases. Increased microbial activity also hastens the breakdown of thatch constituents, demineralization and frees previously bound nutrients, which can reduce the amount of synthetic fertilizer the turf will require.

Organics also increase the plant's ability to absorb nutrients through the roots. They have also been shown to influence critical metabolic processes like turfgrass root-tip development, respiration and photosynthesis.

Adding organic materials to poor soils will improve both soil health and plant quality. Using good sources of humus will provide your tees and greens with soil much closer to what nature first intended them to have. That combination will give your turfgrass a much better chance to survive the brutal summer months. ■

Kevin Hattori is director of public relations for Growth Products, a manufacturer of liquid fertilizers, micronutrients, organics and a microbial inoculant. He can be reached at khattori@growthproducts.com.

Stable Environment

Slow-release fertilizer helps maintain healthy turf on a high-traffic course

BY MICHAEL KARDELIS

Fertilization creativity is a must for a course that handles 200 to 300 rounds per day, as Memorial Park CC in Houston does.

PHOTOS COURTESY OF NELSON SCHMIDT

Maintaining a top-notch golf course while being kind to the environment is tough enough. When you throw in high traffic, it's enough to give a superintendent a migraine.

Memorial Park GC in Houston handles 70,000 rounds per year, almost double the national average for 18-hole municipal courses. Superintendent Jason Harsh had to devise a creative fertilizer strategy to handle the volume of golfers, remain environmentally friendly and provide his turf with proper nutrition.

"Providing an enjoyable and environmentally friendly course is sometimes difficult with a course that handles this many rounds of golf," Harsh says. "But it can be done."

Problem

A high volume of golfers, combined with a commitment to environmental sensitivity, makes creating an adequate fertilizer schedule difficult.

Solution

Stabilized nitrogen fertilizers provide a source of nitrogen that can be applied year-round once a week to provide the turf with proper nutrition despite being overrun with golfers nearly every day.

The problem

Harsh served as assistant superintendent at Memorial Park for one year before taking over as superintendent in June 1997. The grounds crew had been struggling with growing and maintaining turf amid almost constant play. "Few people have been exposed to the problem of accomplishing any maintenance on a golf course that sees 250 to 300 rounds each day," Harsh says.

Heavy tournament schedules and adverse weather tacked on additional complications. Harsh faced a challenge to create a fertilization program that would meet the nutritional needs of the turf while working around the golfers.

"It's a big challenge to produce quality turf," Harsh says. "As most super-

Memorial Park superintendent Jason Harsh says it's a plus that stabilized nitrogen doesn't depend on soil microbes to break it down.

intendents know, we have only a limited time to fertilize."

With so many pressures on the turf program, Memorial Park needed immediate attention.

The solution

Targeting year-round color and constant growth as top priorities, Harsh looked for a fertilizer with a stabilized-nitrogen base.

Stabilized-nitrogen products improve nitrogen efficiency by means of a urease inhibitor and a nitrification inhibitor. The inhibitors modify soil chemistry to extend nitrogen availability. Although stabilized-nitrogen products provide all the benefits of slow-release fertilizers, manufacturing economies make them less expensive than organic, coated and complex-chain products, according to Al Nees, vice president of turf and ornamental sales for Agrotain International, a company that manufactures stabilized-nitrogen products. Since they function like slow-release products, superintendents can make fewer applications year-round.

To meet his needs, Harsh chose UMAXX, an Agrotain product that combines N (n-Butyl) thiophosphoric triamide (NBPT) and dicyandiamide (DCD), which are both inhibitors. NBPT is a urease inhibitor that stops nitrogen volatilization, while DCD keeps the nitrogen in its ammoniacal form longer, which plants absorb more easily. DCD also keeps the nitrogen in the soil longer and prevents leaching and denitrification.

The product doesn't rely on outside agents like water or heat to release its nutrients. Instead, it works in tandem with nature to keep nitrogen in a usable form longer in the root zone. As a result, Harsh can apply less fertilizer.

Harsh uses both granular and liquid applications of stabilized nitrogen to fertilize his course. Because so many rounds are played at Memorial

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With lakes on the course, Memorial Park has to pay close attention to the environmental impact of its fertilizer.

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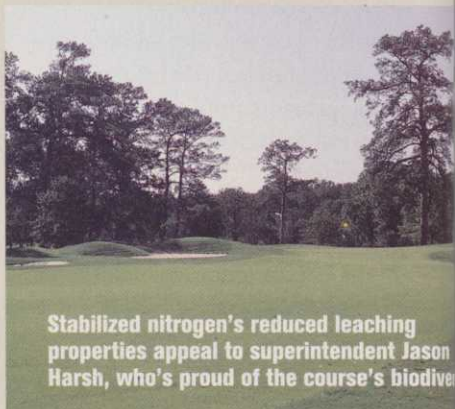
Park each day, he has only one day per week to complete the entire process.

"I can put down a stabilized-nitrogen fertilizer anytime of the year, and it doesn't need to be watered in right away. It isn't dependent on soil microbes to break it down. That's a plus."

As committed as he is to meeting the challenges of healthy turf, Harsh believes passionately in environmental friendliness. He is an active member of the Audubon Signature Program, which promotes wildlife conservation and habitat enhancement. He's proud of the biodiversity on his course, so the reduced leaching properties of stabilized nitrogen also appeal to him.

"Our course provides a place for wildlife to live and players to enjoy rounds of golf, while still being environmentally friendly," Harsh said. "The consistency of the products that I use



Stabilized nitrogen's reduced leaching properties appeal to superintendent Jason Harsh, who's proud of the course's biodive

and involvement from management help keep my course in the best environmental condition possible."

Harsh is proud of the professional appearance at his course, and he believes stabilized nitrogen helps create it. Continuing to uphold the top-notch look of the course with environmentally oriented practices will always be a top priority. ■

The author of this article, Mike Kardelis, is a public relations writer for Nelson Schmidt, a Milwaukee-based advertising and public relations firm. He can be reached at mkardelis@n-s.com.

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STINGING INSECTS

Simple Strategies Manage Stinging Insect Threats

By Jody Gangloff-Kaufmann

Understanding and managing stinging insects is an essential component of recreational safety that is often overlooked until emergencies arise. Stinging insects, including yellow jackets, paper wasps, hornets, fire ants (and some bees), are among the most significant of public health pests. Many people are severely allergic to stinging insect venom. Each year, over 500,000 people enter the emergency room with allergic reactions to venomous insect stings. Up to 150 people die each year. Stinging insects are commonly encountered in the suburban landscape, on or near buildings, in recreational areas, in parks and on golf courses.

Athletic fields, golf courses and parks offer ideal habitats for native and invasive species of wasps that pose a threat to human health.

Like many pests of landscape and turfgrass, stinging insects must be managed for the safety and pleasure of those enjoying recreational areas. A proactive approach, using an integrated pest-management (IPM) strategy, is the best method. This article will focus on common vespid and sphecid wasp pests of recreational grounds and offer tools and ideas for wasp management and prevention.

Athletic fields, golf courses and parks offer ideal habitat for native and invasive species of wasps that pose a threat to human health. Suburban environments are "ecologically disturbed" and may therefore have more pest problems in general. These areas are patchy in composition, with woodlots adjoining fields, ornamental plantings and man-made structures. Together, they provide a variety of habitats in a small area. Suburban environments often contain both natural and man-made resources, such as food and raw materials required for nest making. Most wasps are opportunistic in their choice of nesting areas.

One invasive species is highly successful in surviving in conjunction with human activity, nesting on structures and scavenging in garbage as well as landscapes. Yellow jackets and paper wasps are efficient predators of many common insects considered to be landscape pests, such as cutworms. Protein is their nutritional requirement as young colonies multiply in early summer and can also be scavenged from rubbish and food waste. However, as summer wears on, sugary food sources left behind by humans are a more powerful attractant for hungry wasps.

Parks, golf courses and other recreational areas usually experience a surge in wasp problems in late summer. As a result, abundant and aggressive yellow jackets near the concession stand can repel or, in the worst case, seriously injure the public.

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IN THIS ISSUE

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TABLE 1

Table of characteristics of some common stinging insects.

Species	Common name	Size Color	Colony style	No. of workers
Vespula germanica	German yellow jacket	10-16 mm Yellow/black	Void nest	Can be thousands
V. vulgaris	Common yellow jacket	10-16 mm Yellow/black	Void nest	Can be thousands
V. maculifrons	Eastern yellow jacket	10-16 mm Yellow/black	Void nest	Can be thousands
Polistes dominulus	European paper wasp	16-20 mm Yellow/black	Umbrella	Under 200
P. fuscatus	Common paper wasp	16-20 mm Brown/black	Umbrella	Under 200
Dolichovespula arenaria	Aerial yellow jacket	<15 mm Yellow/black	Enveloped ball, small	Lower than *Vespula spp.*
D. maculifrons	Baldfaced hornet	15-20+ mm Black/ivory	Enveloped ball, large gray color	100-400
Vespa crabro	European hornet	20-35 mm brown, yellow	Enveloped ball, large brown color	200-1,000
Sphecus speciosus	Cicada killer wasp	25-40 mm brown, black, yellow	Single burrows often in clusters	Solitary
Scolia dubia	Scoliid or digger wasp	20-40 mm black w/ yellow spots	Single eggs laid on scarab grubs	Solitary
Apis mellifera	Honey bee	11-15 mm honey brown	Void nest	20,000- 80,000

Additional problems ensue in and around golf courses and athletic fields. Several varieties of ground-nesting wasps and bees may infest these areas.

Cicada killer wasps, scoliid or digger wasps, and a variety of ground-nesting wasps and bees are a few of the typical inhabitants. Although these insects are relatively less dangerous, they may be highly visible and generate anxiety for players and spectators of an event.

Traditionally, pest managers have taken a simple approach to wasps: Treat them immediately with a pesticide. Since only a small amount of insecticide is usually applied, this method is still widely used.

Many practitioners have never required new approaches to wasp management. However, as many municipalities, school districts and other public institutions shift to low-risk pest management policies, old-fashioned common-sense methods and innovative new technologies will become more valuable and widespread.

The importance of sanitation

Among the most important steps to creating a pest-free environment is sanitation. Vespid wasps (which include yellow jackets, paper wasps and hornets), like other public health pests, are scavengers and become a problem in places where human activity occurs outdoors. Simple adjustments to food and garbage handling, combined with other techniques, can alleviate problems with wasps.

Tight-fitting lids or swinging doors should always be secured on trash receptacles. Use a good-quality bag inside that will not break or leak, change bags each time trash is emptied, change trash at sunset (also prevents vertebrate pest problems) or twice a day in early afternoon and at dusk. If the trash cannot be changed frequently, place

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Digger or scoliid wasps hover in large numbers around grassy areas in search of turfgrass-infesting white grubs.

more receptacles around to prevent overflow. Incorporating these techniques into your current waste-management plan can greatly reduce stinging insect problems.

Large trash receptacles, such as dumpsters, should be placed away from human activity and buildings. When this is not an option, hosing or power washing dumpsters and nearby pavement once or twice a week is effective. A school district on Long Island began washing emptied dumpsters with dilute ammonia water to help cut down residue. The district reported that yellow jacket problems had diminished, although the effect did not last more than a couple of days.

When the staff combined quality trash bags, tight-fitting lids, and trash receptacle cleaning, it was able to manage dumpster wasps without the use of pesticides.

Modify the pests' habitats

The suburban environment offers abundant locations for wasp nesting and advantages such as lower predation, warmth and nearby food sources.

Careful scrutiny of structures, including fences and outdoor objects, will reveal nest sites or entry ways into structural voids. Yellow jackets tend to occupy voids in walls and doorways, in trees, abandoned cars, under railway ties and inside rodent burrows. Paper wasps will use various cavities and tend to build a nest near the entrance.

Open fence pipe ends are favored nest sites for paper wasps. Larger nests will be found underneath or within eaves and under metal flashing. Nests are constructed mainly in locations receiving ample sunlight.

Check for patterns of use by paper wasps. Old and new nests will be found in ideal locations year after year. Following detection and treatment or removal of the nest, elimination of the void or nest area by sealing, filling, or blocking is critical to reducing future problems. Be creative when changing the habitat.

Vinyl siding, hardening foam, screen, paint, caulk and steel wool are some materials that can discourage nest building. Building maintenance is clearly a key component of pest control and some buildings will need minor renovations to alleviate pest problems long term.

Naturally occurring harbors can be more difficult to modify. Rodent burrows will continue to turn up as long as mice, rats and larger mammals live on the grounds. When an abandoned rodent burrow or one occupied by ground-nesting yellow jackets is located, it should be filled with fine *dry* sand, preferably at night. If occupied by yellow jackets, the process may need to be repeated several times because some yellow jackets will dig their way out.

Hornet nests built close to the ground in sensitive areas should be approached at night, bagged and frozen or treated. When nests appear high in trees, don't bother.

Sandy dry areas that attract cicada killers, such as playgrounds and sand bunkers, can be fitted with hardy landscape cloth buried 4 to 6 inches below the surface. Regular overhead irrigation during the window of cicada killer activity (mid July through late August) will discourage females from burrowing in the area. Since cicada killers prefer bare soil areas, planting turf in bare spots will also reduce their numbers. Cicada killers are beneficial insects that should be managed only when absolutely necessary.

How to trap them

Many styles and brands of wasp traps have been marketed in recent years. Some use wet foods as attractants and others have dry food-based chemical attractants. There is certainly a place for trapping in any wasp management program. Traps have been found to capture yellow jackets and paper wasps in great numbers, along with a smaller number of hornets. They can be used to monitor the types and relative numbers of wasps in an area early in the season and help control wasps later on.

To optimize trapping, find a good location. Sunny places away from the nest are optimal. Choose the best bait for the locality. Try a variety of baits. Beer, grenadine, pineapple or apple juice, and fruit punch have great attraction, as well as the syrup from canned peaches and pears.

Every situation is different and guaranteed to change over time, so the baiting may need adjustment. Baits are especially handy when facing a problem that doesn't originate on the property you own or manage, but won't be effective when an alternate and more attractive food source is nearby.

Combining traps with sanitation makes both strategies more effective.

Granular Fungicide Carriers and DG Pro™ Technology

In recent years, the golf industry has become increasingly aware of the value of playing on well-maintained, smooth, fast greens, and the demand for such surfaces across the country continues to grow. In order to satisfy this increased demand for premium-quality playing surfaces, leading manufacturers have responded by reducing particle sizes for granular products, and by developing new control product carriers that disappear quickly into the turf canopy with a minimum of water. Particle size is very important, but the ability of the active ingredient to move off the carrier quickly is critical for effective disease control. State-of-the-art granular products from The Andersons provide both benefits. These technological developments enable granular products to be safely and uniformly applied, even to the lowest-cut turf.

Granular fungicide carrier technology has evolved over the years from clay to corn cob to pulp to the latest innovation from the Andersons — DG Pro Technology. DG Pro, a proprietary water dispersible particle, represents a real breakthrough in granular carrier technology. DG Pro will be available in a variety of particle sizes ranging from SGN (Size Guide Number) 75 for low-cut greens to SGN 150 for fairway applications.

DG Pro™ technology is superior to other granular carriers for several reasons:

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- More particles per square inch helps improve the efficacy of fungicide treatments.
- Particles are designed for minimum dust and drift to improve applicator and non-target safety.

The Andersons will be converting several granular fungicides to DG Pro beginning this spring. Fungicide VII (Triadimefon), Insecticide III (Chlorpyrifos), Golden Eagle, (Myclobutanil) and Systemic Fungicide (Thiophanate-Methyl) are slated to be among the first products to utilize this new technology.

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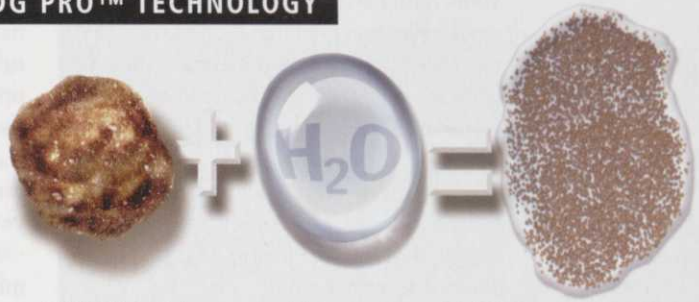

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The paper-nest building wasps are aggressive defenders of their hives.

Pesticide use

Conventional pesticides used to control stinging insects include carbamates and, more commonly, pyrethroids, in dust and/or aerosol formulations. Aerosols are often applied to hornet and yellow jacket nest openings or directly to paper wasp nests. Dusts are used in voids. Both have residual effects that result in quick reduction or elimination of wasp nests. However, many practitioners are making a conscious effort to find lower-risk solutions.

Botanical sprays, including mint oil and a patented hexa-hydroxyl formulation (derived from plant oils), are among the compounds available to replace traditional sprays in municipal pesticide phaseouts in New York, for example.

A dust formulation of the hexa-hydroxyl product is also exempt from EPA pesticide labeling due to its food-grade ingredients. Approved for stinging insects, it has insecticidal *and* repellent qualities.

Other products include dust and spray formulations of pyrethrins. Whether lowering pesticide use is the goal or not, pesticides should always be combined with sanitation and habitat modification for more permanent and reliable pest control.

Precision wasp baiting has been tested in places where invasive wasps are wreaking havoc on local ecosystems. The technique may have possibilities in the United States as a way to reduce or eliminate nests from highly sensitive areas.

Biological control, using commonly occurring insect pathogens, is another potential low-toxic solution, though care must be taken when using generalist insect pathogens so as not to infect non-target organisms. Researchers are investigating the potential of fungi for wasp control.

Educate your patrons

In many cases, nothing can or should be done to completely eliminate wasps. In fact, elimination is an unrealistic goal in most pest management situations. Educational tools can pick up where pest management leaves off, helping the public to understand how they can further lower their risks. The educated customer can be an ally, particularly if he or she supports your efforts to reduce pesticide inputs.

As we attempt to improve pest management and reduce environmental and human health risks from the use of pesticides, we must also weigh the risks posed by certain pests themselves.

Stinging insects can be life threatening to some but may only be a nuisance to others. Managing wasps in a proactive and safe way, an IPM way that integrates various tools, ensures that the needs of many are met and the goals of protecting human health and the environment are also reached.

Jody Gangloff-Kaufmann, Ph. D., is an entomologist and IPM specialist with the Cornell University Community IPM Program. Based in Long Island, N.Y., her work focuses on development and implementation of pest management programs that reduce reliance on pesticides, particularly in school and municipal settings. Recent collaborative projects include evaluation of integrated and alternative methods of stinging insect management.

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Seashore Paspalum Offers Alternative for the Future

By Ronny R. Duncan and R.N. Carrow

Beginning with funding from the USGA in 1993, a dedicated effort was initiated to genetically enhance seashore paspalum for golf course use.

The grass has been around for centuries, actually evolving on sand dunes exposed only to ocean water in South Africa. It's somewhat ironic that this grass evolved in the same country as the African bermudagrass, but was never recognized for anything other than its ability to grow in salt-affected environments. Seashore paspalum was duly noted as surviving the saline and moist habitats that dooms most bermudgrasses.

Legendary turf professor O.J. Noer was instrumental during the 1950s for moving the grass around the southeastern United States and Hawaii. A renewed effort occurred during the 1970s and 1980s with the import of cultivars from Australia. Worldwide movement of this grass has been documented (Duncan and Carrow, 2000).

Beginning in 1993, a systematic breeding and management research program was started at the University of Georgia-Griffin to fully exploit the potential recreational use of this species for golf courses on salt-affected sites where other warm-season grasses have failed. It can also be used in places with alternative non-potable water resources, including effluent and brackish sources. Because of these stress challenges and increasing need for water conservation and environmental stewardship, simply releasing new cultivars was not sufficient. A parallel management protocol program was instituted.

Promising ecotypes were sent to golf courses for the "final exam" to determine performance in a real-world situation.

Fairbanks Ranch CC in Rancho Santa Fe, Calif., is helping to pioneer seashore paspalum research.

The research

Initial breeding efforts at the University of Georgia started at the same point at which most breeding programs involving a "new" grass do — assembling a collection of ecotypes from around the world, followed by implementation of an evaluation program to assess the turf traits and the true genetic potential of the species.

At the same time, mother nurseries were established in Griffin, Ga., to start looking at the ecotypes in turf-plot situations. We exposed the plots to rotary mowers and eventually reel mowers when the plot sizes increased to simulate green, tee, fairway, landscape or sports field conditions to determine mowing tolerance and to eliminate ecotypes that produced unsightly seedheads. Drought-, acid-soil-, and salinity-tolerance studies were initiated, as well as wear and traffic studies to assess the individual ecotype levels of multiple-stress resistances.

DNA analysis studies were implemented to build a true genetic databank on the new ecotypes as compared to the old cultivars. Insect studies were initiated in concert with entomologists to determine the level of resistance to fall armyworms, spittlebugs, mole crickets and white grubs.

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was instigated at the same time as the breeding and evaluation program. The initial mowing height studies included taking the heights down to one-eighth inch to find green types and to identify ecotypes that should only be mowed at fairway or rough heights. Derivatives of the old cultivars were noted for their inability to be mowed cleanly during the hottest times of the growing season and were subsequently eliminated from the program.

Establishment studies identified those types that could root and grow rapidly. Herbicide efficacy studies were instrumental in identifying the tolerance or sensitivity of each ecotype to various herbicides. Encroachment studies looked at bermudagrass movement into paspalum and paspalum movement into bermudagrass.

New experimental herbicides were tried against the cultivars. Cold-hardiness studies were used to determine the northernmost region of survivability for the specific ecotypes.

Kapolei GC in Oahu, Hawaii, benefited from greens-grade seashore paspalum.

All of these preliminary trial results were used to find the one or two ecotypes with the best combination of turf traits that could be increased in volume vegetatively, since this species is planted by sprigs or sod. The promising ecotypes were sent to golf courses for the "final exam" to determine their performance in end-use, real-world situations. The result from all of this testing was the emergence of SeaIsle 1 (for fairways, roughs, tees, landscapes, sports turf) and SeaIsle 2000 (for greens and tees), with formal release by the University of Georgia in 1999.

Attributes

Great diversity exists among seashore paspalum ecotypes for all turf characteristics. Choice of cultivars with university-researched attributes is essential. SeaIsle 1 and SeaIsle 2000 exhibit the following attributes when compared with other grasses:

- Highest salinity tolerance of all warm-season grasses — the best cultivars are true halophytes.
- Can withstand most alternative water resources with varying levels of salinity, including effluent, brackish and, in extreme cases, short-term use of ocean water with proper management.
- Superior low-light intensity tolerance involving prolonged cloudy, rainy, foggy or smoggy conditions.
- Forms both rhizomes and stolons, and readily responds to verticutting, grooming or slicing.
- Wide soil pH range of 3.6 to 10.2, but the optimum range for maximum performance is 5.5 to 8.
- Excellent drought tolerance when managed properly. The root system must be trained deep into the profile with judicious irrigation scheduling.
- Wear and traffic tolerance similar to the bermudagrasses.
- Low-mowing height tolerance, with optimum ranges of one-eighth inch for SeaIsle 2000 and .25 inches to .75-inches for SeaIsle 1. Roughs mowed above 2 inches are definite penalty roughs. Landscapes can be managed in the 1-inch to 2-inch range.
- Can be overseeded with most cool-season grasses, but the dense canopy warrants use of a verticutter to ensure good seed-soil contact for the cool-season grass.
- Capability to root and persist equally well in pure sands, heavy clays and mucks or bogs.
- Can effectively and efficiently take up heavy metals or other contaminants.
- Excellent waterlogging or low oxygen tolerance. Can be inundated for short intervals with minimal detrimental effects.
- Capable of providing an effective buffer zone between environmentally sensitive areas and less sensitive areas (fairways or roughs transitioning into wetland areas and sand-dune stabilization).

• Chilling tolerance that provides prolonged color retention into the fall or winter months. Normally the last warm-season grass to go off color. SeaIsle 2000 actually has the best winter-hardiness.

• Seedheads for monostands of a cultivar do not readily produce viable seed. SeaIsle 2000 produces minimal seedheads during the growing season.

• Does not form a grain; holds the striping pattern exceptionally well.

• Looks like Kentucky bluegrass or perennial ryegrass — shiny, glassy dark green hue.

• Has a nutrient uptake and use system that is quite efficient.

Limitations

Every turfgrass has pluses and minuses, and seashore paspalum is no different. Some of the limitations include:

• Minimal shade tolerance, with similar responses to bermudagrass under tree canopies. It needs about six to eight hours of sunlight daily for good performance.

• Cold-hardiness similar to most of the hybrid bermudagrasses and actual adaptation to the southern transition zone in the United States.

• Cannot be effectively and rapidly established with irrigation water high in salinity (more than 5,000 parts per million of total salts) due to suppression of growth. Juvenile roots of all turfgrasses are sensitive to salt levels in the irrigation water, and paspalum is no different. Salinity tolerance of mature turf is substantially higher than immature turf.

• Few pesticides are specifically labeled for seashore paspalum.

• Seedheads may persist with some other cultivars that are on the market during certain months of the growing season.

• Lack of understanding the interactions among paspalum cultivars, salinity in the irrigation water, soil buildup of salts and the microenvironments on the golf course or on other sites, which necessitates specific changes in paspalum management to maximize long-term performance.

• Doesn't like to be scalped. Excess nitrogen can lead to succulence and enhanced scalping, thereby predisposing the grass to pathogen attack.

Future research and educational activities

A refinement of the management practices for greens is receiving top priority. Additional greens-type cultivars have been identified and are being increasingly produced for on-course evaluations.

A seeded hybrid cultivar is in preliminary production and evaluation and may be on the market in three to five years. The breeding is always focused on the development of new and improved cultivars, with promising experimentals having ocean-level salinity tolerance and improved multiple insect resistance.

A lawn/landscape cultivar has been identified and is being evaluated in Florida. A nematode assessment is being collaboratively investigated in South Carolina and Florida. The potential for enhancement of low-light intensity tolerance and subsequent management are under investigation, along with studies on irrigation scheduling and water uptake/use efficiency for paspalum.

Seashore paspalum will normally be grown in environments where salinity or poor water quality is an issue.

This grass is an environmentally friendly grass with multiple uses and multiple stress tolerances. As the grass increases in acreage in end-use situations and is exposed to the challenges of Mother Nature, more information will be gleaned and translated into a refinement of management protocols for specific stress environments.

Ronny R. Duncan and R.N. Carrow are professors in turfgrass breeding and stress physiology in the University of Georgia's department of crop and soil sciences at the University's Griffin campus. Duncan has been working with developing grasses for multiple stress environments, including drought, acid soils, high and low temperatures, high-bulk density soils and salinity stresses. Carrow has spent his entire career in turfgrass research, with expertise in environmental and traffic stresses. They can be reached at rduncan@gaes.griffin.peachnet.edu and at rcarrow@gaes.griffin.peachnet.edu, respectively.

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New Breeding Technology Speeds Innovations to Market

By Terrance P. Riordan

Throughout the short history of turfgrass breeding, the major objectives have been fairly consistent. For cultivars propagated vegetatively, the breeding objectives have been turfgrass quality, color, density, establishment vigor, sod strength and pest resistance. For cultivars that are propagated by seed, the breeding objectives also include seed yield, seed germination and seedling vigor in addition to the others.

It is interesting to study the National Turfgrass Evaluation Trial (NTEP) data to see how well turfgrass plant breeders have done in improving the various characteristics of the important species.

To evaluate the improvement, I looked at the NTEP final report data from the 1995 Kentucky bluegrass high-input trial. This report summarizes all the data that was taken on this trial from 1996 through 2000 at 29 locations throughout the United States. I've been involved with NTEP trials since the first one in the early 1980s and have developed a number of personal Kentucky bluegrass standards that can be used to compare to the current cultivars and experimentals that were included in this most recent trial.

This most important characteristic evaluated in all NTEP trials is turfgrass quality. This rating, along with all other ratings, is carried out using a 1 to 9 scale where 1 is a poor rating and 9 is outstanding.

The first evidence that plant breeders have made significant improvement is observing where certain cultivars, in this case my personal standards, rank in the trial. The standards I used and looked at in this trial and their rating, as well as their rank compared to other cultivars in the trials, respectively, are Midnight (6.4, 1), Glade (6.0, 23), Baron (5.5, 83) and Kenblue (4.7, 103). These cultivars — Midnight, Glade, Baron and Kenblue — represent my standards from the 1990s, 1980s 1970s and 1960s, respectively.

Midnight is an excellent cultivar and it has been at or near the top of the rankings since its release. Glade and Baron are good cultivars and, in the first NTEP trials, would have been some of the more highly ranked cultivars. They were used in blends for years and are probably components for much golf course turf and lawns of the last 25 years. Kenblue is an example of a common, non-improved cultivar, and its low rating sets a base for minimum turfgrass quality.

To show the improvement that has been made since the 1990 NTEP trial, the rating and ranking for these same four cultivars in the 1990 trial were Midnight (6.2, 1), Glade (5.9, 7), Baron (5.5, 76) and Kenblue (4.6, 122). It's interesting that the ratings did not change much from the 1990 to 1995 trials, but the ranking for Glade and Baron both moved down. This seems to suggest that there are higher ranked cultivars and experimentals, and this is what we should observe if breeders continue to improve cultivars.

The data discussed is the overall mean for the 29 locations over five years. Therefore, small differences are significant as indicated the lowest statistical difference (LSD) value of 0.1 indicates. Midnight, which I use as a personal standard, is still good in the 1995 trial, but there are other cultivars equally good.

In summary, we have more Kentucky bluegrasses with excellent turfgrass quality. Remember, however, that the overall mean score only indicates how broad-based the adaptation and performance is for a cultivar. You should look at all the turfgrass quality data by state and by region to determine which cultivars you should select for your blend or mixture.

Genetic color

Genetic color is another important characteristic where plant breeders have made improvements. In the 1990 NTEP trial, Midnight had the best color (7.5) and ranking (1) for genetic color. Blacksburg, Ascot and two other cultivars not included in the 1995 trial were rated 7.1 and ranked No. 2 for genetic color.

In the 1995 trial, Midnight is still rated and

ranked well (7.8, 3), but Moonlight (8.0, 1), Total Eclipse (7.8, 2) and an experimental VB 16015 (7.8, 4) are as good or better. Also, there are another 18 cultivars and experimentals that have a better genetic color than Ascot, the widely used cultivar in the 1990 trial. Genetic color is an easy characteristic to observe and measure, and it's obvious improvements were made.

Other areas of improvement relate to the tolerance to pests and other stresses. A review of data taken at various test sites shows that improvements have been made for a number of the problems of Kentucky bluegrass. Summer patch is a significant problem in bluegrass, and improvements in resistance to this disease can be used as an example of improvements in the resistance to other diseases. In the 1991, NTEP trial, Midnight, the highest ranked of my standards, received an average 7.5 rating, but there were 30 cultivars and experimentals that rated higher. However, the LSD value for this characteristic was 1.5 (summer patch is a much harder characteristic to evaluate), and thus Midnight was in the top-ranked statistical group.

The other three standards, Glade (7.3), Baron (6.8) and Kenblue (6.3), all ranked in the lower half of the trial. In the 1995 trial, the rating and ranking were fairly comparable: Midnight (7.8, 18), Glade (7.4, 36), Baron (6.9, 67) and Kenblue (6.1, 90). With more, and probably better, data taken, the LSD value was a lower .8. In the 1990 trial, although ratings were slightly higher, there were only a few cultivars and experimentals than were included in the 1995 trial, making it slightly more difficult to gauge improvement.

The new, higher-rated cultivars in the 1995 trial were Apollo, Princeton, Unique, Platini, Baritone, Showcase and Unique. Although several of these new cultivars have shown excellent turfgrass quality, it will be interesting to see if their resistance to summer patch continues.

Billbugs, drought

Two other important characteristics are billbug tolerance and drought tolerance. Midnight has fairly good billbug tolerance. In evaluations at three locations, it had a rating of 7.3 and was the eighth best cultivar. Glade (6.2), Baron (5.8) and Kenblue (5.9) were only average in performance.

Several new experimentals (ZPS-2183 and PST-P46) and cultivars (Bartitia, Blackstone, Moonlight, Ascot and North Star) were rated above Midnight and show potential improvement in this characteristic. This is important because the amount of pesticide can be reduced each time a plant breeder incorporates tolerance or resistance to a turfgrass pest.

Drought tolerance was evaluated at three potentially drier locations — Kansas, Minnesota and Utah — in the 1995 trial. Midnight was the best of my standards with a rating of (6.1,16), and the other standards had the following ratings and rankings, respectively: Glade (5.1, 42), Baron (4.0, 91) and Kenblue (4.7, 63). As water becomes a more precious natural resource and alternative species are considered that will conserve water, drought tolerance in Kentucky bluegrass becomes important. Even thought Midnight, Glade and Baron are good cultivars with excellent turfgrass quality, obviously they are not particularly tolerant of drought conditions. However, the performance of Unique (7.2), Apollo (7.2), Brilliant (7.1) and Showcase (7.1) show improvements have been made and will be made in the future. I hope I've shown that turfgrass breeders have made significant progress over the last 10 to 20 years in Kentucky bluegrass.

Other varieties

Equally significant improvements have been made in tall fescue, perennial ryegrass, creeping bentgrass, bermudagrass, zoysiagrass and buffalograss. Improvements have been made across the board in turfgrass quality, genetic color, pest tolerance, drought tolerance and almost every other characteristic that relates to the use of the various turfgrass species.

We now have better performing species and cultivars that have greater sod strength, wear tolerance and establishment vigor. It's possible that we could continue to carry out conventional breeding work in the future, but breeders now have new tools and the potential for improvements is almost unlimited.

Biotechnology

Let's look briefly how biotechnology will affect those of us working with turfgrasses.

For example, if we make a turfgrass more disease or insect resistant, we will not need to apply as much pesticide to control the problems. Another reason biotechnology is being considered for use in the turfgrasses is new cultivars can be protected by a patent. Therefore, the company that invests in biotechnology will be rewarded. Another reason that we are using biotechnology is that we now have the tools required to transfer a gene from one organism to another.

Years of research using agronomic crops moved science to the point where it is possible to do in a laboratory in a few months what it took breeders years to do, if it could be done at all. The potential improvements that can be made using the tools of biotechnology include improved color, slower growth, insect and disease resistance, drought and heat tolerance, cold tolerance, and finally Round-Up resistance, the characteristic we hear the most about.

What the risks are

Are there risks to this technology we should be concerned about? In my work with buffalograss and Round-Up resistance, I have thought about this a great deal. First of all, I don't think we're changing the species enough to have a significant ecological effect. Adding Round-Up resistance has no more ecological effect than improving color, density or quality using conventional breeding procedures. It's probably more of a factor when a breeder develops a cultivar that has increased vigor or rate of spread than making it Round-Up resistant.

This article demonstrates some of the progress that has been made over the past 25 years with turfgrasses using conventional plant breeding procedures. I have tried to show that biotechnology is going to allow us to continue making progress at a more rapid rate.

Terry Riordan is a professor in the agronomy and horticulture department at the University of Nebraska. He has been a turfgrass breeder his entire career, including eight years for the Scotts Co. For the last 16 years he focused on buffalograss and eight turf-type cultivars have been released from the program. He can be reached at triordan@unl.edu.

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Midnight, Glade, Baron and Kenblue represent standards from the 1990's, 1980's 1970's and 1960's, respectively. They are also included in the NTEP Trials.

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07 ○ 60 Golf Course Architect
08 ○ 70 Golf Course Developer
09 ○ 90 Golf Course Builder
10 ○ 105 University/College
11 ○ 115 Distributor/Manufacturer/Consultant
12 ○ 100 Others Allied to the Field (please specify)_____

2. Which of the following best describes your title? (fill in ONE only)
13 ○ 10 Golf Course Superintendent
14 ○ 15 Assistant Superintendent
15 ○ 25 Owner/Management Company Executive
16 ○ 30 General Manager
17 ○ 35 Director of Golf
18 ○ 70 Green Chairman
19 ○ 45 Club President
20 ○ 75 Builder/Developer
21 ○ 55 Architect/Engineer
22 ○ 60 Research Professional
23 ○ 65 Other Titled Personnel (please specify)_____

3. What is your facility's annual maintenance budget?
24 ○ A More than $2 Million
25 ○ B $1,000,001-$2 Million
26 ○ C $750,001-$1 Million
27 ○ D $500,001-$750,000
28 ○ E $300,001-$500,000
29 ○ F $150,001-$300,000
30 ○ G Less than $150,000

4. If you work for a golf course, how many holes are on your course?
31 ○ A 9
32 ○ B 18
33 ○ C 27
34 ○ D 36+
35 ○ E Other (please specify) _____

Please send Golfdom to the following people at my organization:

Name _____
Title _____
Name _____
Title _____

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101	113	125	137	149	161	173	185	197	209	221	233	245	257	269	281	293	305
102	114	126	138	150	162	174	186	198	210	222	234	246	258	270	282	294	306
103	115	127	139	151	163	175	187	199	211	223	235	247	259	271	283	295	307
104	116	128	140	152	164	176	188	200	212	224	236	248	260	272	284	296	308
105	117	129	141	153	165	177	189	201	213	225	237	249	261	273	285	297	309
106	118	130	142	154	166	178	190	202	214	226	238	250	262	274	286	298	310
107	119	131	143	155	167	179	191	203	215	227	239	251	263	275	287	299	311
108	120	132	144	156	168	180	192	204	216	228	240	252	264	276	288	300	312
109	121	133	145	157	169	181	193	205	217	229	241	253	265	277	289	301	313
110	122	134	146	158	170	182	194	206	218	230	242	254	266	278	290	302	314
111	123	135	147	159	171	183	195	207	219	231	243	255	267	279	291	303	315
112	124	136	148	160	172	184	196	208	220	232	244	256	268	280	292	304	316