gangs if it wasn't for The First Tee. We're saving lives, changing lives and influencing lives."

So it bothers Barrow when outsiders cite golf, including The First Tee, as an elitist sport. Those people should hear the stories from the people whose lives have been positively impacted by the organization before passing judgment, Barrow says.

"Before people get so cynical, they need to talk to the parents who have all of the sudden seen their children go from a very wrong direction to a right direction because of their involvement with golf," he says.

Barrow also takes exception to people who say golf is too expensive and that the kids who move on from The First Tee won't be able to afford to play. Yes, there are country clubs that cost thousands to join and high-end public courses that cost $100 a round, Barrow says. "But there are plenty of municipal and public courses where you can play golf for $10, $15 and $20 on weekends," he adds, noting playing nine holes of golf, which most beginners only want to do, costs about as much as going to the movies.

Barrow says he's excited about The First Tee National School Program, where the organization's philosophy is introduced in a school setting and taught by physical education instructors. The program is in 2,800 U.S. schools and has reached 14 million elementary school children.

"We're excited about it because it's our first real effort to go where the

Continued on page 62

Ron Kopco got his son, Jason, involved in The First Tee of Cleveland because it teaches character traits similar to that of the Boy Scouts.

Passion Required to Oversee a Chapter, as First Tee of Cleveland's Evans Proves

In one of the worst economic downturns ever, The First Tee of Cleveland experienced its best fund-raising effort ever in 2009. That's a credit to Doris Evans, The First Tee of Cleveland's executive director, who brought the passion the organization needed to succeed when it began in 1999.

"Doris has made a difference with her leadership," says Joe Louis Barrow, CEO of The First Tee, the national organization that oversees more than 200 national chapters, including Cleveland.

The First Tee teaches kids how to play golf. But Evans' passion is to help participants grow into responsible adults, not necessarily good golfers. She places tremendous emphasis on the organization's Life Skills Experience, where participants learn valuable lessons about the importance of maintaining a positive attitude, how to make decisions by thinking about the possible consequences and how to define and set goals from the golf course to everyday life. Evans also favors the organization's teaching of its Nine Core Values, including honesty, integrity, sportsmanship, respect, confidence, responsibility, perseverance, courtesy and judgment.

"We have a philosophy — you don't teach core values, you demonstrate core values," says Evans, who is a pediatrician in the Cleveland area. "If a child sees that you're an honest person, he or she may want to be honest. But you can't tell that child to be honest. So we expose them to these concepts by our behavior."

The First Tee of Cleveland celebrated its 10th anniversary this year with a golf outing at Shaker Country Club near Cleveland. Former Cleveland Indians slugger Andre Thornton, who began the Cleveland chapter with Evans, attended the event. "Doris loves children and has devoted her life to helping

Doris Evans: "You don't teach core values, you demonstrate core values."

them," Thornton says. "I feel good about the organization after 10 years."

Thornton says he helped spearhead the project because he knew it would be a positive group for kids to join. "When you have an opportunity to do something worthwhile, you should do it," he says.

The crown jewel of The First Tee of Cleveland is the Washington Golf Learning Center, a nine-hole, par-29 golf course and 30-station driving range designed by Brit Stenson of the International Marketing Group. The course opened in 2006.

Evans credits Dave Donner, superintendent of Washington Golf Course, for providing a top-shelf course, not to mention teaching the kids about agronomy. Evans also says The First Tee of Cleveland's board, staff and volunteers have contributed significantly to the program's success.

Evans is retiring from her post next summer. She says she's overjoyed about how far the Cleveland chapter has come, but there's still plenty of work to be done before going.

"To do this kind of work, one has to feel a calling," Evans says. And one must have a passion to provide that service, she adds. "If you feel that way, you will convey it in everything you feel and do," Evans says.

– Larry Aylward

PHOTO BY: LARRY AYLWARD

Continued from page 61

young people are," Barrow says. "Being able to introduce golf and the Nine Core Values and Life Skills Experience in a school setting has had a positive influence on those young kids."

Barrow says The First Tee has come a long way in a short time. In 12 years, it has succeeded in growing the game and growing children's lives.

"The most important investment we can make in our society is with young people," Barrow says. ■

TURFGRASS TRENDS

THE SCIENCE OF TURFGRASS

The Origin of Turfgrass

How grasses came to life — and still live

By Richard J. Hull

Turfgrass is an important part of the landscape throughout the world. Golf is a popular activity in tropical, semitropical and temperate regions. This is true because turfgrasses exist that are well-adapted to both hot and cold climates. But as every superintendent knows, no one grass performs well under both of these conditions.

Turfgrasses come in two flavors: cool-season grasses that grow well when temperatures are in the 65 to 75 degree Fahrenheit range, and warm-season grasses that grow best between 80 and 95 degrees F. Cool-season grasses can be killed by prolonged high temperatures, but they go dormant and survive when temperatures are well below freezing. By comparison, warm-season grasses go dormant when temperatures drop into the low 40s to 30-degree range but generally do not survive being frozen. In Southern states, green turf can be enjoyed during the winter months when dormant warm-season grasses are overseeded by cool-season grasses.

In the North, cool-season turf is green in winter only if grown on heated soil or if the dormant turf is painted green. Grasses seem unable to compete with crabgrass during July and August yet hold their own against these invaders during late spring and early fall. These observations are symptomatic of fundamental differences between cool- and warm-season grasses. What happens to cool-season turfgrasses when they become less vigorous during hot weather? Conversely, why do warm-season grasses appear to be indifferent to elevated temperatures but can't tolerate the cold?

Photosynthesis is the problem

When looking for the reason why the growth and survival of a grass responds to an environmental variable, in this case temperature, it is often useful to observe the impact of that variable on basic physiological processes. For a plant's growth and survival, there's nothing much more basic than photosynthesis. If you measure the rates of net photosynthesis (the rate of carbon dioxide (CO_2) fixation) as temperature increases, you will find the photosynthetic rate increases steadily for a warm-season grass until the temperature approaches or exceeds 100 degrees.

When you make the same observation using a cool-season grass, you'll observe an increase in CO_2 fixation as temperatures reach 70 degrees but a progressive decline in CO_2 fixation at higher temperatures. This means that at high temperatures, warm-season grasses have more energy and resources available to support their growth than cool-season grasses.

This doesn't fully explain the differences in heat tolerance among grasses but only suggests that photosynthetic CO_2 fixation may be the heat-sensitive process. To further understand why photosynthesis is inhibited by high temperatures in some plants, but not so inhibited in others, it may be useful to consider the findings of paleoecologists.

Continued on page 64

IN THIS ISSUE

OUR SPONSORS

PHOTO COURTESY: DICK HULL

The tees, fairways and greens of this Southern golf course are overseeded with a cool-season grass. Its warm-season bermudagrass borders are dormant and brown.

Continued from page 63

Their research will take us to the origins of photosynthesis — back to the early Precambrian Era and the beginning of life, about 3.5 billion years ago when the Earth was only 1 billion years old.By that time, the earth had acquired much of its water, and life is thought to have evolved near thermal vents in the deepest parts of these primordial seas. Single-cell, bacteria-like organisms were likely the earliest life forms, deriving their energy to synthesize carbon compounds and reproduce by oxidizing reduced sulfur and other chemicals present in seawater. Their primitive respiration involved an electron flow based on oxidizing hydrogen sulfide (H_2S) and reducing nitrogen oxides, metals and what little oxygen might be present.

This occurred in the darkness of oceanic depths but apparently it didn't take long for sunlight at the ocean's surface to be used to drive the chemistry by which electrons from sulfur compounds reduce CO_2 to form carbohydrates (CH_2O) required by living cells.

For light to serve as a source of energy, a photon-capturing pigment was needed and chlorophyll evolved to serve that function. In time, the availability of reduced S-compounds became limiting and cells evolved the means to use water as the reductant (electron source) for reducing (fixing) CO_2.

A byproduct of this reaction was free oxygen (O_2) that initially was present in the atmosphere and oceans at very low concentrations but gradually increased as photosynthetic organisms (cyanobacteria) became abundant throughout the oceans. Over the following 2.5 billion years, the atmospheric O_2 concentration increased from only a trace (less than 1 percent) to near the present 21 percent. As O_2 became more abundant, it emerged as the dominant terminal electron acceptor (oxidant) for respiratory metabolism until virtually all plants and animals became dependent upon this gas (oxidative respiration).

The O_2 released into the oceans and atmosphere by microbial photosynthesis was initially consumed by the oxidation of metals dissolved in oceanic waters and exposed at the surface of rocks. As these metals became oxidized, O_2 accumulated in the atmosphere, where it reacted with hydrogen (H_2) that was formed when solar ultraviolet (UV) radiation was absorbed by water molecules splitting them to H_2 and O_2. Hydrogen, being extremely light, would be lost to space unless there was sufficient O_2 present for it to recombine and again form water. As atmospheric O_2 concentrations increased, ever more H_2 was recaptured, preventing the massive loss of water.

In addition, O_2 also interacted with UV radiation forming the triatomic molecule ozone (O_3) that accumulated in the upper atmosphere and effectively absorbed most UV radiation shielding the Earth's surface from its destructive effects. It was the formation of an O_3 layer that made the colonization of land by plants and animals possible. Because water absorbs the energy of UV radiation, it shielded life in the oceans, allowing marine life to evolve and flourish there long before an O_3 layer had formed. However, because the O_2 from which O_3 was produced is a product of photosynthesis, life has transformed the Earth.

In photosynthesis, light isn't used directly to reduce CO_2 and make simple sugars. Rather, high-energy intermediate compounds are formed through photochemical reactions and these energize and donate electrons to the carbon of CO_2 (four electrons per carbon). This reduction of CO_2 occurs in a complex biochemical pathway known as the Calvin Cycle, named after Melvin Calvin, who was awarded the 1961 Nobel Prize in chemistry. The primary step in the Calvin Cycle is the reaction that chemically binds CO_2 to the five-carbon sugar ribulose bisphosphate (RuBP). The catalyst for that reaction is an enzyme that bears the name ribulose bisphos-

phate carboxylase/oxygenase — or RubisCO. The complete reaction involves the binding of CO_2 to RuBP (carboxylase), forming an unstable six-carbon intermediate that then splits to form two molecules of the three-carbon acid: phosphoglyceric acid.

The two three-carbon acids (PGA) pass through the Calvin Cycle, where the carbon from CO_2 is reduced to the level of a carbohydrate and a RuBP is regenerated to accept another CO_2 and keep the cycle going. Because the first chemical products of CO_2 fixation via the Calvin Cycle are two PGAs, this pathway is referred to as C-3 photosynthesis and plants that fix CO_2 in this way are C-3 plants.

When RubisCO emerged, there was very little O_2 in the atmosphere or in the seas. But as we outlined above, its concentration increased dramatically over the 2 billion years that followed. High O_2 levels represented a potential problem for RubisCO because the site on the enzyme that binds CO_2 will also bind O_2. When this occurs, the enzyme functions as an oxygenase and produces, from RuBP, one molecule each of PGA and a two-carbon acid phosphoglycolate. The PGA enters the Calvin Cycle but P-glycolate enters a different pathway that consumes an O_2 and liberates a CO_2, effectively nullifying any net CO_2 fixation. Because this pathway utilizes O_2, releases CO_2 and only occurs in the light, it is often called photorespiration.

RubisCO has a stronger affinity for CO_2 than it has for O_2 and as long as plant life was confined to the seas, it functioned efficiently. This is because seawater contains abundant carbonate and bicarbonate that are in equilibrium with dissolved CO_2. As CO_2 in sea water is consumed by photosynthesis, it's replaced by bicarbonate and carbonate so a constant supply of CO_2 is always maintained.

However, when plants colonized the land, their photosynthetic organs (stems and leaves) were no longer surrounded by water. Land plants had to obtain their CO_2 directly from the atmosphere. Initially this was not a problem because the Earth's atmosphere contained abundant CO_2. During the Cambrian biological explosion of 500 million years ago, atmospheric CO_2 concentrations averaged 0.5 percent or 5,000 parts per million (ppm). That's 14 times the 360 ppm CO_2 in today's atmosphere. With so much CO_2 available, the greater affinity of CO_2 over O_2 for the RubisCO binding sites insured that the enzyme's carboxylase function (CO_2 fixation) would dominate over its oxygenase activity (photorespiration).

As vascular plants spread over the continents during the Devonian and Carboniferous Periods and vast amounts of carbon as plant debris were buried in sediments, atmospheric CO_2 levels declined. By the beginning of the Permian Period (300 million years ago, CO_2 concentrations were less than 1000 ppm and, while they rebounded during the 200 million years that followed, CO_2 levels periodically dropped below the 300 ppm level during the Cenozoic Era (65 million years ago to the present).

When ambient CO_2 concentrations in the atmosphere are between 250 and 350 ppm, the concentration of CO_2 dissolved in the sap of photosynthetic leaf cells is less than 10 micromolar (less than 0.44 ppm). At that CO_2 concentration, the CO_2 fixing activity of RubisCO is less than 50 percent of its maximum rate and, as the temperature increases, the CO_2 levels drop even further (gasses are less soluble in water as its temperature increases). Thus, when leaf temperatures approach 90 to 95 degrees Fahrenheit, their photosynthetic rate is reduced by about 75 percent. Under these conditions, photosynthesis will barely equal respiration and a plant cannot survive that way for long.

If our story ended here, turfgrasses probably would be found only in the temperate zone where summer temperatures rarely exceed 90 degrees and then only for short intervals. No turfgrasses would survive in the warm humid or warm arid zones and only with difficulty in the transition zone. How the warm-season grasses solved the high temperature problem will be the subject of this story's continuation in a future issue.

Hull is a professor of plant sciences at University Rhode Island in Kingston, R.I.

REFERENCES

Beard, J.B. 1973. Turfgrass: Science and Culture, Prentice-Hall, Englewood Cliffs, NJ, Chapter 17.

Lane, Nick. 2002. Oxygen: The Molecule that Made the World. Oxford University Press.

Velvet Bentgrass And Sustainable Golf?

Variety may be environmentally friendly without diminishing quality of the golf experience *By John Stier*

Tough economic times and increasing environmental regulations are causing golf course superintendents to look for more sustainable management practices. Part of the answer may lie in using grasses that require less inputs.

Virtually all of today's superintendents and golfers are familiar with only two types of putting green grasses: creeping bentgrass, which is considered desirable, and annual bluegrass (*Poa annua*), which is often considered to be a weed except in the Pacific Northwest. However, as Americans look to develop more sustainable cropping systems, sometimes they are finding that older types of plants may provide the desired sustainability characteristics. This may be a very pertinent point with regards to bentgrasses, as creeping bentgrass cultivar development has relied on ready access to fertilizer, pesticides and water.

The extremely fine-leaf texture of velvet bentgrass is one of the first characteristics people notice about velvet bentgrasses. This characteristic once made velvet bentgrass a preferred putting green turf in the United States, until problems with its seed production intersected with the availability of seeded creeping bentgrass. An attempt in the 1970s to re-introduce velvet bentgrass depended on the light-green colored Kingstown, which failed as managers may have over-fertilized it without controlling the thatch which subsequently developed (Brilman and Meyer, 2000). Recent research indicates nitrogen (N) rate, vertical mowing and topdressing don't influence thatch accumulation of the newer cultivar SR7200, at least in the first few years after establishment (Boesch and Mitkowski, 2007).

Some researchers indicate velvet bentgrass may have lower N and irrigation requirements than creeping bentgrass (Skogley, 1975; DaCosta and Huang). Several new velvet bentgrass cultivars have been developed since the 1990s by breeders in the Pacific Northwest and in New England. Cultivars such as Vesper and SR7200 have demonstrated as good or better wear tolerance compared to creeping bentgrass (Samaranayake et al., 2008). A demonstration project at the Green Course of Bethpage State Park indicated velvet bentgrass greens had lower pesticide requirements than mixed creeping bentgrass/*Poa annua* putting greens (Grant and Rossi, 2004).

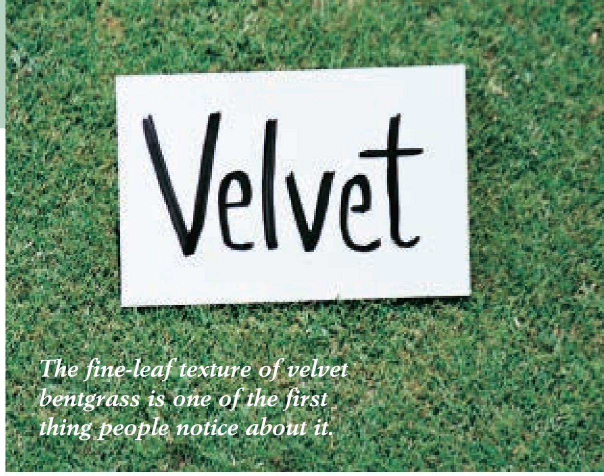
Previously, all research on velvet bentgrass for putting greens has been conducted on the Eastern coastline of the United States on soils with acidic pH. Textbooks claim velvet bentgrass is only suited for use in the New England and Northwest Pacific coastal areas. These same textbooks state that creeping bentgrass requires a similar soil pH, yet superintendents throughout the United States grow creeping bentgrass on soils with pH well above 7.0.

Wisconsin superintendents have questioned if velvet bentgrass could be grown on the higher pH soils and harsher climate of the Midwest. Our goal was to determine if velvet bentgrass could be maintained as putting greens on United States Golf Association sand-based root zones with basic pH (7.5) and under low and moderate N rates (48 and 146 kilograms (Kg) N per hectare per year).

Plots were seeded June 2004 and a starter fertilizer (15-25-8) was applied to supply 21 kg of phosphorus (P) per hectare (0.5 pounds P per acre). Additional fertilizer was applied five times during 2004, providing a total of 195 kg N per hectare. We began fertilizer and mowing treatments in the spring of 2005.

A granular fertilizer was used, 21-3-12,

Continued on page 68



The fine-leaf texture of velvet bentgrass is one of the first thing people notice about it.

PHOTO BY: LARRY AYLWARD

Continued from page 66

containing about 20 percent water-soluble N. The lowest rate was split into three applications made in May, July and September, while the higher-rate treatments were applied monthly from May through October. We compared Vesper and SR7200 to two creeping bentgrass cultivars, Penncross and L-93, under three mowing heights (2.5, 4.0 and 6.4 millimeters).

The greens were irrigated to replace 75 percent of estimated evapotranspiration (ET) losses four times weekly (we usually irrigate greens in our area daily to replace 100 percent ET losses). Traffic was applied from May through September, using a roller outfitted with golf spikes, to simulate 21,000 rounds of golf annually. Fungicides were applied curatively to allow us to collect information on disease resistance.

We didn't necessarily show that velvet bentgrass requires less N than creeping bentgrass (Koeritz and Stier, in press). In fact, there were enough differences between the two velvet bentgrasses in a number of characteristics that we concluded it's not always appropriate to make generic statements about velvet bentgrasses.

Vesper had as good or better turf quality than creeping bentgrasses in individual monthly ratings. Ultimately, our N rates appeared to be too low to provide the really high quality typically expected of golf course greens in the United States.

Vesper velvet bentgrass did prove to be as adaptable to low mowing height as creeping bentgrass. While Vesper mowed at the 4.0 mm height provided the best turf quality of any grass by mowing height combination, its turf quality was still just as good as the creeping bentgrasses at the lowest mowing height of 2.5 mm. In fact, the low mowing height seemed to favor velvet bentgrass: creeping bentgrass plants occurred in the velvet plots, probably as seed wafted in during establishment, yet the amount of creeping bentgrass in velvet turf diminished as mowing height decreased. The lower mowing heights also decreased dollar spot disease, particularly in Vesper.

Green speeds, tested every two weeks for two years, were similar between the velvet bentgrass and Penncross and lower for L-93 (Koeritz and Stier, in press). The greatest visual differences between the velvet bentgrasses and creeping bentgrasses were in color and density. Velvet bentgrasses had much better green color.

Where do we go from here? We've established that velvet bentgrasses can grow as well as creeping bentgrasses on high pH sand-based root zones. They may require less fungicide inputs, but don't necessarily need less N. We're now comparing N rates and carriers across sand and silt loam soil types.

We're also comparing the shade tolerance of velvet and creeping bentgrasses for putting greens, as well as studying the use of velvet bentgrass alone and in mixtures for low maintenance, low water-use fairways.

John Stier, Ph.D., is a professor of environmental turfgrass science and chair of the department of horticulture at the University of Wisconsin-Madison.

REFERENCES

Brilman, L.A., and W.A. Meyer. 2000. Velvet bentgrass: Rediscovering a misunderstood turfgrass: Past mistakes have damaged an excellent species reputation. Golf Course Manage. 68:70-75.

DaCosta, M., and B. Huang. 2006. Deficit irrigation effects on water use characteristics of bentgrass species. Crop Sci. 46:1779-1786.

Garrison, M.A., and J.C. Stier. Cool-season turfgrass colony and seed survival in a restored prairie. Crop Sci. In press.

Grant, J.A., and F.S. Rossi. 2004. Evaluation of reduced chemical management systems for putting green turf. USGA Turfgrass Environ. Res. Online 3:1-15.

Koeritz, E.J., and J.C. Stier. Nitrogen rate and mowing height effects on velvet and creeping bentgrasses for low-input putting greens. Crop Sci. In press.

Samaranayake, H., T.J. Lawson, and J.A. Murphy. 2008. Traffic stress effects on bentgrass putting green and fairway turf. Crop Sci. 48:1193-1202.

Skogley, C.R. 1975. Velvet bentgrass putting greens: Fertilizer and topdressing management. USGA Green Sect. Red. 13:7-9.

TURFGRASS TRENDS

INDUSTRY ADVISORS

Jerry Quinn
John Deere

Scott Welge
Bayer Environmental Science

Kevin Cavanaugh
Floratine


Push Water
Pervade

The Company Line

PRODUCTS & SERVICES

New Fungicide, Herbicide

BASF Professional Turf & Ornamentals has launched Honor fungicide, a combination of two active ingredients, and Tower herbicide, which features dimethenamid-P, a new active ingredient for the turf market. The company says both products give golf course superintendents broad-spectrum control to help them optimize applications.

Honor fungicide combines boscalid, the active ingredient in Emerald fungicide, and pyraclostrobin, the active ingredient in Insignia fungicide. Ideal for greens, tees and fairways, Honor's two modes of action deliver playability to greens and control of diseases, including patch diseases, anthracnose, dollar spot and leaf spot.

Tower herbicide provides pre-emergent control of more than 50 small-seeded grassy and broadleaf weeds and sedges including goosegrass and yellow nutsedge. Tower can be applied to cool- and warm-season turfgrass on tees, fairways, roughs and other amenity turfgrass around common areas on the golf course. For added weed control, Tower is an ideal tank-mix partner with Pendulum AquaCap herbicide.

"Both products enable golf course superintendents to cost effectively control diseases and weeds that threaten the health and quality of turfgrass," said Toni Bucci, Ph.D., business manager of BASF Professional Turf & Ornamentals.

Honor is labeled for use on golf courses turfgrass, and should be applied prior to or in the early stages of disease development for optimal results. Tower is labeled for use on golf courses except on greens, in landscape or grounds maintenance, on mulch beds, jogging and bike trails, non-crop areas, parking lots, fence lines and other areas listed on its label.

Assisting Turfgrass Research

To support the industry, **Precision Laboratories** is facilitating a program that allows golf course superintendents in several Southern states to help the golf course maintenance industry conduct research and superintendents manage their own resources. Precision Laboratories will make a $12.50 donation for every case (or case equivalent in drums) of its "Best of Class" products that superintendents purchase in their early orders. The donations will be directed to the turfgrass associations in superintendents' respective states. Participating states include Florida, South Carolina, North Carolina, Virginia, Georgia, Alabama, Tennessee and Louisiana.

"The turf industry contributes jobs, money and recreation to communities across the country," the company said. "As university research budgets are cut, private funding needs to fill the gap to ensure that turf managers continue to have access to best practices."

New Pricing Program

A new simplified year-long purchase program from **Syngenta Professional Products** is designed to provide maximum flexibility to golf course superintendents, the company says. The Syngenta GreenTrust 365 Purchase Program, which began Oct. 1, provides incen-

November THIS MONTH'S HEALTH TIP

Everything ends up in your puppy's mouth. For instance, it might just be an electrical cord to you, but it's a chew toy to your dog. Keep in mind that your puppy will chew anything, so keep dangerous items out of reach. Encourage puppies to chew on toys by providing lots of them, especially new toys when the old ones have lost their appeal.

Dingo. His owner is Josh Sawyer, superintendent at Keowee Key Golf and Country Club in Salem, S.C. *(Photo by: Josh Sawyer)*

LebanonTurf *Improving the Way Professionals Care for Turf*