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I was running my hands through a slow-release form of phosphorous, nitrogen and magnesium. It's also a sustainable product, as it's produced by recovering phosphorous from renewable resources. Crystal Green is citrate-soluble with low water solubility, making the granules release slowly over the growing season. The nutrients are slowly distributed in response to plant demand, the company says. So when the roots are satisfied, Crystal Green stops releasing until the next growth period.

Clearly, it's all over my head — I'm the guy who runs his hands through random stuff at conventions, after all — but lucky for me, more can be learned at crystalgreen.com.

Turfco

I stopped by the Turfco booth to visit with Scott Kinkead, executive vice president. He told me that the Widespin 1550 underwent some improvements. Among them, it has 20 percent more capacity, a wider hopper opening and a better system for knowing what your application is. They've gone to what they call the "app culture" and made an easier-to-use home screen so it's not up to the superintendent (or the most mathematically gifted guy on the crew) to set the rate. Now you can just plug in the "greens" rate and it automatically goes to what the superintendent has pre-programmed. Push the "fairways" button, and... you get it.



The TriWave 40 also got some work done. It used to be this was a reactive piece... guys only took it out when there was a problem. Now it can be backed up to a Gator and on the course faster, making it easier to use for preventative maintenance. "For the first time ever, a guy can go out every two weeks and just touch up problem spots," Kinkead said.



OK, that's all the space I have for this issue, but I promise you there's more in my notebook. I'll share it as the year goes on in our regular "Golfdom Gadgets" feature.



THE GOLFDOM CONVERSATION

Arnold Palmer and Matt Beaver

BY SETH JONES

Sure, it's called the Arnold Palmer Invitational. But we never thought that Mr. Palmer would actually invite us.

If the King invites you to his tournament, you go. And we did.

Over the course of the tournament we got a lot accomplished. (For a complete rundown of the action, visit www.golfdom.blogspot.) We talked to Tour players, we talked to superintendent



Matt Beaver, we got a lot of great photos and we even saw a few old friends.

But the singular most exciting moment was getting to meet Palmer in person. In a strange bit

of coincidence, that meeting between *Golfdom* and Mr. Palmer somehow got a brief mention in an Associated Press story that ran around the country (see page 11 for more on that bit of trivia.)

While we had the ears of Mr. Palmer and Mr. Beaver, we asked a few questions of both men. Here are our conversations...

Golfdom: Mr. Palmer, thanks so much for your time, it's truly an honor.

Arnold Palmer: My pleasure, thank you.

G: My first question is in regards to the founder of this magazine, Mr. Herb Graffis. I have the good fortune of sitting in his chair today, but I never had the opportunity to meet the man. Can you tell me a little about him?

AP: Herb was a good friend. We spent a lot of time together, mostly just kibitzing and talking about golf and what (*Golfdom*) does and the things that were important for people to read about in the game of golf... and how superintendents react to the various situations that arise in the process of being a superintendent.

G: I hear he was quite a character...?

AP: Oh, he was a character — he always had a good joke!

G: I was speaking with an architect recently and he told me that 'golf isn't as down as the media is trying to lead everyone to believe.' What's your take on that statement?

AP: I've been reading a little bit about the economy and what is happening to golf. The only place I've seen an appreciable downturn is the construction of new golf courses. (New course constructions) are starting to rev up a little. I think we'll be building some courses, and redoing some courses. (And) rounds played are increasing and will increase in 2013.

G: Good, good. I think we're both in the right business.

AP: Ha! Good. Me too.

G: Can you tell me how things are going for your design company right now?

AP: Mostly right now, (we're doing) repairs or upgrading courses. We have some potentials in Mexico, South America, China and a couple of very likely prospects in the United States. The business is not that bad.

G: You have a long history with superintendents, since your father was one...

AP: My father was a golf course greenkeeper, a superintendent. He started digging ditches when they were building the course (Latrobe CC, Latrobe, Pa.) So he learned the job from the bottom up, and he was there all his life. That was over 50 years of work on the course. And he did



everything from changing cups to cutting fairways to waxing skis so people could ski on the golf course — things that probably people don't hear about much today.

G: How do you think that job has changed over the years?

AP: Well, I suppose it's more of a supervision job now. Some supers get out in the dirt, and do the job physically, a lot are more signal callers, I suppose you could say — they direct and supervise more than they do the work itself. There's a combination of types. Some like to drive the mowers, some use the shovels, and then others would rather be supervisors and study the new techniques for greenkeeping.

G: What do you look for when you're hiring a superintendent?

AP: Details. A lot of what I look for in a super is if he's paying attention to the details of maintaining a golf course. That is very important to me and something I watch constantly. Simple little things like where they turn the mowers, and how they turn the mowers, whether it be a greens mower or a fringe or a tractor-trailer mower, whatever. How careful they are — there's a lot of damage that can be done just by maintaining a golf course.

G: Is there any equipment or new products in the maintenance shop that have caught your eye lately?

AP: It's amazing to watch golf course maintenance equipment evolve over the years. Our Jacobsen mowers have become so flexible that even one machine can be used on many different parts of the golf course. This helps our superintendent, Matt Beaver, and his crew to get more done in less time. Overall, I think Jacobsen is doing very well with the various types of new equipment that they're integrating into our industry.

G: What can you tell me about Matt Beaver, the superintendent at Bay Hill Lodge & Club?

AP: He has been here about 10 years and is doing an excellent job. He's a great young man and someone I'm particularly interested in... helping him and keeping him doing the things that he's doing so



Wayne Flannagan (left) and Craig Shelton, the two assistants at Bay Hill. "It's good to have someone around who has your back," Beaver says of the duo.

“A lot of what I look for in a super is if he's paying attention to the details. That is very important to me.”

ARNOLD PALMER

well now. And he will continue to do well. I think — well, I know — the course is about as good as it's ever been.

G: Those are my questions, thanks so much for your time Mr. Palmer, and especially for the kind words about Mr. Graffis.

AP: Of course, my pleasure.

Matt Beaver, superintendent at Bay Hill Club & Lodge, started out as an intern at the course 12 seasons ago. After

graduating from Iowa State University he moved to Orlando to work on the crew. After working his way up, he became the head superintendent when the position opened up three years ago.

Golfdom: Matt, we've talked to a few of the Tour players, and they're raving about the course. Brandt Snedeker said, "It's as primo as I've ever seen it," and Charley Hoffman called it "the best I've ever seen it." What do you attribute this success to?

Matt Beaver: The weather's been helpful. Any time you get the weather in your favor, it sure helps. And I think that since 2009, when we did the renovation, when you do a renovation you always have a few issues here and there, and as you tie those up, you learn a few things, you get better and better.

G: You've had several international guys helping out this week, how did that come about?

MB: Yes, we've got Stuart from Ireland, and two kids that came down just for the tournament as part of the Ohio State program; Ping from China and Ty from Viet-

Continued on page 34



// A NICE CHAT



After the conclusion of the 2013 Palmer Invitational, Palmer (center, in blue) headed to the maintenance shop to thank the crew.

Continued from page 33

nam. They've been great for us. Those guys work their tails off and they're really interested in this business. It'd be hard to do it and do a good job without them.

G: Tell us about your assistant superintendents, Craig Shelton and Wayne Flannagan.

MB: Craig's been around the business a long time and came back into it, and has been working for us for about eight years. Craig's a great sounding board for me. For me, it's good to have someone around like that who you can trust, who you know has your back, and has seen a lot of things. His experience is very important. I like to pick people's brains, because you don't know everything.

Wayne started out on the crew, he had

never worked out on a golf course before. Wayne's 62, maybe 63 this year, and that guy just is a hell of a worker. You know you can always count on him. Sometimes, one of the most important things is to have somebody you know will be there for you, no matter what. He's willing to do whatever you ask him to do and take on new things. And at that age, that's pretty unique.

G: What kind of equipment are you guys running?

MB: We've got the (Jacobsen) 1880s in the fairways, the Eclipse 22-inch and 18-inch running on our greens. They provide us with a lot of flexibility, a lot of good options, so maybe we can reduce the amount of times we have to mow over the greens by changing our frequency of clip. Not only now, during tournament, but during the rest of the year, member events, those

kinds of things, it's been a welcomed addition to what we're doing — really effective.

G: What's your favorite thing about tournament week, and the tournament in general?

MB: Mr. Palmer, and seeing it on TV. It's unique, it's his golf course, everything is associated with his name... proceeds go to the hospital with his wife's name on it. (My wife and I have) had two kids. We were fortunate enough to have both kids at the Winnie Palmer Hospital for Women and Babies. It's a special place, they take care of you.

G: What's it like working for Mr. Palmer?

MB: It's just like everybody thinks it is — he's very good to work for, very honest. If he sees something, he's going to talk to you about it. But he understands from our aspect, what it's like to try to do this. As far as a person to work for, I don't think there could be any better.

G: Got any good Palmer stories to share?

MB: One just happened — following the tournament, he came down to the shop to thank all the crew for their hard work. Everyone got time to say hi and even take a few photos with him. He appreciates that these guys like seeing him and being around him.

G: That's great, Matt. Thanks to you and your staff this week, and a big thanks for setting time aside for us on what we know is a busy week for you and your team. Nice work!

MB: Thanks Seth, we sure appreciate it.



Beaver addresses the crew before they head out for an afternoon shift during the week of the Arnold Palmer Invitational.

PHOTO COURTESY: MATT BEAVER (TOP) BY SETH JONES (BOTTOM)



Super Science

// FUNGICIDES

IMPACT OF STROBILURIN APPLICATIONS ON SEASON-LONG TURFGRASS HEALTH

By Brandon Horvath, Ph.D.

Four summer fungicide programs consisting of five applications on a 14-day interval were applied to a creeping bentgrass putting green in the transition zone. Strobilurin fungicides, pyraclostrobin, azoxystrobin, fluoxastrobin and trifloxystrobin were applied at the second and fifth spray interval while all other applications were held constant across treatments. Measurements of visual quality, spectral reflectance, percent cover, turfgrass rooting and disease severity were collected.



Despite extensive root zone sampling, season-long applications of strobilurin fungicides result in differences that remain elusive.

showed reduced brown patch severity compared to the very active disease present in non-treated control plots. There were few significant differences among the strobilurin programs, and the differences that were present were related to the various products' abilities to control disease.

No other season-long differences were observed for any of the other parameters measured other than those influenced by a product's ability to control disease. This research indicates that the plant health effects that are possible with this class of fungicides are transient and potentially short-lived.

Contact Brandon Horvath, Ph.D., assistant professor of turfgrass pathology at the University of Tennessee-Knoxville, at bhorvath@utk.edu for more information.

No treatments were statistically different in the first year, and significant differences were not observed in the second year until 42 and 56 days after initial treatment, when fungicide programs exhibited greater visual quality, turfgrass cover and spectral reflectance than non-treated control plots.

During the same time period, fungicide-treated plots also

GAMES GRASS

OLYMPICS CHOOSES ZEON ZOYSIA FOR GOLF AT THE 2016 GAMES

When golfers tee off in Rio de Janeiro at the 2016 Summer Olympics, they'll be doing it on Zeon zoysiagrass. Frank Rossi, Ph.D., confirmed at this year's Golf Industry Show.

Rossi, an associate professor of horticulture at Cornell University, is a consulting agronomist on the Olympics project. "Everything approaching the greens, 88 percent of the grassed area, will be Zeon zoysia," he stated in a press release from Bladerunner Farms, which bred the grass.

That means approximately 88 acres of the Olympics course will be Zeon zoysiagrass, including tees, fairways and roughs. By choosing Zeon zoysiagrass, which requires little maintenance and few inputs, those involved say the selection committee showed its desire to have a sustainable golf course at these games — the first to feature golf in more than 100 years.

"It will be an example of sustainability and preservation of an environmentally protected area," said the president of Rio 2016, Carlos Arthur Nuzman, in the release.

Bladerunner Farms President David Doguet added, "The grass will create a world-class playing surface for the Olympics, and for many years to come."

SUSTAINED HIGH

TEMPERATURES, COUPLED WITH OTHER CONTRIBUTING FACTORS, OVERCOME THE PLANT'S DEFENSES, AND DECLINE BEGINS."

Erik H. Ervin, Ph.D.

(see full story on page 36)

// PUTTING GREENS

Cytokinins and seaweed extracts for summer putting green health

By Erik H. Ervin, Ph.D.

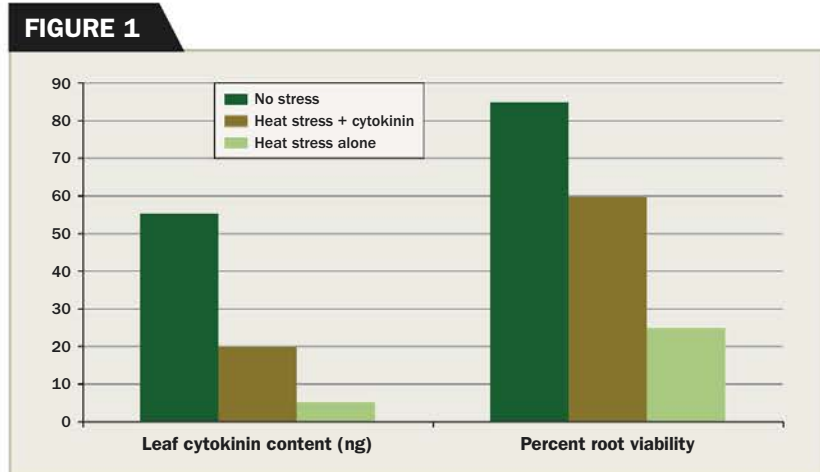
Summer decline of creeping bentgrass and *Poa annua* putting greens is becoming so prevalent in the upper South and transition zone that many courses have converted to ultra-dwarf bermudagrass. However, for those keeping their cool-season greens, the issue of summer decline remains, indicating that we must understand it and implement best practices for prevention.

Summer decline begins when upper root zone temperatures reach above 85 degrees F consistently. Sustained high temperatures, coupled with low mowing heights, mechanical stresses and disease pressure begin to overcome the plant's physiological defenses, and decline begins.

The speed of decline is influenced by a number of factors, some more manageable than others. Bruce Martin, Ph.D., of Clemson University contends that "fans are the best new fungicide that have come on the market in years." And he's right. You can prevent summer decline by improving the physical environment. And you can do that by increasing air movement and decreasing the extent and duration of high root zone temperatures, whether through fans, tree removal, precision irrigation or venting.

The next pieces of the prevention

Bruce Martin, Ph.D., of Clemson University contends that "fans are the best new fungicide that have come on the market in years." And he's right.



High natural leaf cytokinin content under no stress correlates closely with high root viability. Under 95°F heat stress, root zone injection of a synthetic cytokinin translates into greater subsequent leaf cytokinin content and root viability when compared to not applying cytokinin. Data adapted from Liu and Huang. 2002. *Crop Science*. 42:457.

puzzle include spray inputs, such as fungicides, fertilizers, colorants, PGRs, wetting agents and cytokinin-based biostimulants.

WHY CYTOKININ-BASED BIOSTIMULANTS?

Cytokinins are a type of phyto-hormone that direct a number of growth and stress-response processes. For growth, they signal cells to divide at the crown, so new roots, shoots and stems begin to develop. For stress response, they act to inhibit the action of senescence-inducing enzymes, slowing

the degradation of chlorophyll and maintaining photosynthetic rates and root viability. In short, cytokinins are known as the "stay green" hormone. Cytokinin levels must remain elevated in leaf tissues to slow the summer decline process. They're produced in healthy root tips and translocated to shoots via the transpiration stream. Consequently, as summer root decline proceeds, leaf tissue cytokinin levels drop.

Knowing the potential stress-protective effects of cytokinins from the plant physiology literature, in the early 2000s Bingru Huang, Ph.D., of Rutgers University investigated whether root injection of synthetic cytokinin would alleviate heat stress decline of creeping bentgrass (Figure 1).

The results were quite positive, showing that greater maintenance of chlorophyll and photosynthesis was related to increased leaf tissue cytokinin

content. This, in turn, resulted in 35 percent less root loss.

Concurrent with Dr. Huang's research on root-injected cytokinins, my research group developed the hypothesis that the relatively high background levels of natural cytokinins in seaweed extracts (SWE) would most likely also boost creeping bentgrass tissue cytokinin levels and have similar positive stress-protective effects.

My published results with SWE-based cytokinins are in Figure 2. These data show that repeated (14-day) foliar applications of SWE over 42 days of heat stress resulted in leaf cytokinin contents that were just below that of non-heat stressed creeping bentgrass and 42 percent higher than heat-stressed creeping bentgrass that had not received SWE applications.

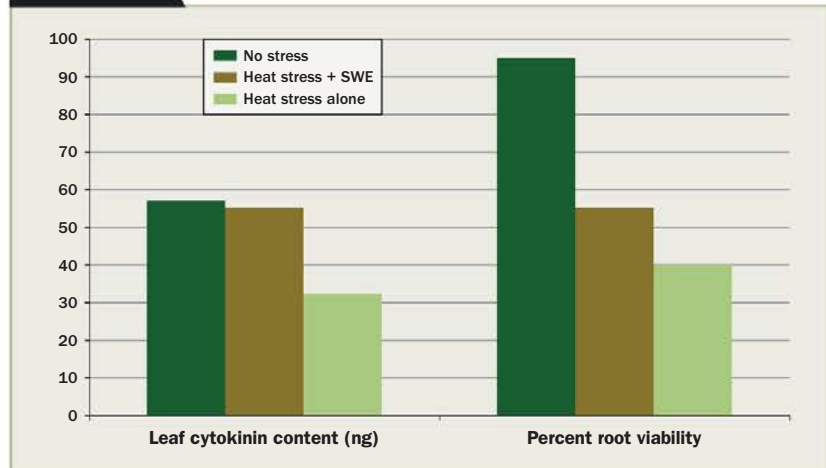
Boosted leaf tissue cytokinins due to SWE foliar application translated into 15 percent less root decline over the 42-day heat stress trial.

These SWE positive results have been repeatable. My group has published research showing similar effects for cool-season turfgrasses subjected to drought, salinity and UV-light stress. Dr. Huang's subsequent research has shown that creeping bentgrass can be genetically modified to "turn on" more cytokinin production in the early stages of stress detection, resulting in transformed lines that retained 50 percent or more root mass under drought stress than the comparable commercial cultivar. For the immediate future, superintendents will not have access to "cytokinin-overproducing" genetically modified varieties, so let's turn our attention back to the more natural approach of supplementing with SWE.

DOES SOURCE AND PROCESSING MATTER?

Where do the SWEs used most commonly in commercial biostimulant formulations come from and how are they processed? They most commonly come from *Ascophyllum nodosum* or north Atlantic rockweed, harvested

FIGURE 2



High natural leaf cytokinin content under no stress correlates closely with high root viability. Under 95°F heat stress, foliar application of a SWE translates into greater subsequent leaf cytokinin content and root viability when compared to not applying cytokinin. Data adapted from Zhang and Ervin. 2008. *Crop Science*. 48:364.

off the coasts of Maine, Nova Scotia, the United Kingdom and Scandinavia (see photo, page 38). The information on processing below was provided by Ocean Organics Corporation of Maine.

Different intended uses require different processing. Moving from least refined to most specialized, we start with **dehydrated whole plants**. Called "seaweed" or "kelp" meal, they are used as soil amendments. The terms seaweeds, seaplants and kelp plants are used interchangeably.

These products are sometimes dried in the sun, in oil (or wood-fired) commercial dryers or in both. The proposed benefits to incorporating kelp meal into the soil are to increase the cation exchange capacity, add micronutrients, provide natural complexed sugars that may promote microbial health and increase water-holding capacity. The whole plants contain plant hormones and other plant active compounds, but the fate of those molecules is unclear due to the variables associated with the product's decomposition in the soil.

The next step along the processing continuum would be the liquefaction of the plants. **Liquefied kelp** are basically whole seaplants reduced mechanically

to small enough particles so that they can be sprayed — basically applying the whole seaplant as a liquid. This is effectively a liquid version of dried seaweed. Proportionally, there is much more organic matter in this type product, but it degrades faster in the soil. It's likely that some of the water-soluble hormones and other plant active compounds remain intact for foliar or soil uptake.

Cold process extracts. There are several companies using this approach. It is the breaking down of the plant cells through mechanical (not chemical) means, but it doesn't include the whole plant in the way liquefied products usually do. I haven't worked with any companies that use cold processing to produce SWE.

The next step would be chemical extraction or leaching of the plant active compounds. These are the classic extracts that have been the focus of the research results I am presenting in this article.

Alkaline extracts. Kelp is chemically digested at high pH. This method most likely began when farmers added wood ashes to seaweed to make a tea. This is the largest category with

Continued on page 38



A. nodosum on the coast of Maine.

Continued from page 37

respect to the number of variations on the concept, and probably the gallons produced.

Alkaline SWEs are the compounds used exclusively so far in my research trials. They're the filtered mixtures of suspensions of the soluble and insoluble parts of the kelp. Heat is typically part of the process, and the temperatures used vary with the processor. Some processors use temperatures well above the boiling point of water. The end product of an alkaline extraction is often dehydrated to a black powder or flaked product to be remixed with water.

Processors planning to produce a powder aim to chemically and mechanically digest the kelp to maximize the yield of the soluble and suspendable solids. Settling out of the suspended solids in these products is sometimes a problem.

Cytokinin levels must remain elevated in leaf tissues to slow the summer decline process. As summer root decline proceeds, leaf tissue cytokinin levels drop.

DOES RATE MATTER?

It's a valid question since we are dealing with hormones-compounds that cause plant growth changes at very low concentrations (nanograms or 10^{-9}) in plant tissues. If these compounds are over-applied will we see abnormal or injurious growth responses? Or, since it only takes nano-changes in concentrations to have positive growth effects, can standard spray rates be reduced? The cytokinin levels in the undiluted SWEs that we tested have ranged from 5 to 125 parts per million (ppm or 10^{-6}). At normal dilution rates, we have compared two SWE sources applied

at 3.5 ppm each or what amounted to about 3 to 4 oz. SWE per 1000 ft². Under heat stress we compared this 1x rate (3 oz.) to 0.1x and 10x rates for effects on creeping bentgrass.

Our results showed that rate mattered in terms of applying enough. The 0.1x rate did not supply enough cytokinins to match the improvements seen with turf quality, chlorophyll levels and nitrate uptake provided by the 1x rate. However, these positive heat stress tolerance effects were matched by the 10x rate, with no negative consequences. The 10x rate did not provide any measures of improved stress

tolerance over the 1x rate, so save your money and stick with the label.

DOES PLACEMENT MATTER?

I don't think so. Standard practice in our trials is to foliar apply then lightly overhead irrigate the next day. In one study, however, we foliar applied and sub-irrigated. Both methods demonstrated similar results in the trials. As far as root absorption is concerned, Huang's research showed positive results when the cytokinin was syringe-injected to the root zone. So go ahead and stick with the standard practice of foliar application, with the only worry of activity loss being if application is followed by a large rainfall or irrigation event.

DOES TIMING MATTER?

Our research indicates that cytokinin levels are optimized under optimal temperature and moisture conditions (such as conditions that can occur in the spring and fall) and cannot be boosted to an extent that makes a plant health difference. However, as temperatures increase in late spring, and the chances for stretches of 7 to 14 days of unseasonable heating or drying increase, our recommendation is to begin applications.

Our research has shown that a 30-day interval between applications can suffice at first, but as heat and plant metabolism rates increase, we recommend shortening the interval to 14 days. The shorter interval in the hottest summer weather is due to the fact that cytokinins and other ingredients in SWEs are organic and break down faster in the environment and in the plant as temperatures increase.

DOES MIXING WITH A PGR MATTER?

There are small amounts of other hormones, such as auxin and gibberellic acid (GA), in SWEs. So will a tank mix of SWE with an anti-GA PGR cancel each other out? We have looked at this question over a summer season

on a putting green in Virginia with an alkaline SWE, mixed or not with Primo.

There were never any clipping yield differences between Primo by itself or mixed with the SWE. However, in comparison to a fertilizer control or Primo + fertilizer, the Primo + SWE plots consistently displayed the highest summer quality.

Are there other biostimulant products on the market that contain higher levels of GA that could be a cause for concern in terms of negating PGR effects? Yes. Always pay attention to labels and question product reps closely about such issues before tank-mixing.

Summer stress will most likely continue to be relentless in the coming years. SWE-based biostimulants can help, but they must be part of a larger cultural management program that revolves around creating and maintaining a physical environment that promotes air movement and temperature moderation.

Erik Ervin is a professor of turfgrass culture and physiology at Virginia Tech. He can be contacted at eervin@vt.edu.

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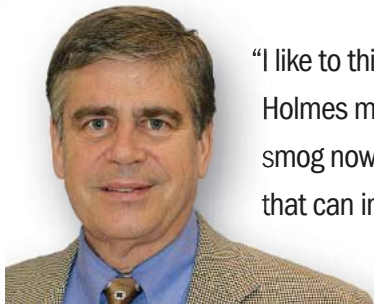
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"I like to think the fog in those early Sherlock Holmes movies was actually smog. For the record, smog now refers to any decrease in air quality that can impact visibility and human health."

KARL DANNEBERGER, PH.D., *Science Editor*

Trying to see through the smog

I could not remember the last time I thought about smog. Until, that is, I ran into a few superintendents from China at the 2013 Golf Industry Show in San Diego.

From what I was told (and later confirmed through my own research), for the last few months the smog levels in Beijing and other Chinese cities have been so horrific that hospitals have been overrun with people suffering respiratory problems, stores are running out of face masks and the government is ordering people to stay inside.

Having traveled to Beijing several times myself, it came as quite a shock to hear that the metropolis's streets were quiet and nearly deserted due to high smog levels.

It also came as a surprise to hear that the Chinese government this year finally acknowledged the severity of the smog problem. In the past, officials routinely downplayed it, calling the smog "fog."

"Smog" originally described the combination of smoke and fog that often reduced visibility in European cities during the early 1800s. I like to think the London fog in those early Sherlock Holmes movies was actually smog. For the record, smog now refers

to any decrease in air quality that can impact visibility and human health.

Smog occurs when gas and particle emissions derived from industrial causes and compound-producing internal combustion engines are trapped by local weather conditions that enhance the chemical reactions and increase their concentration in the atmosphere.

In the United States, vehicles are the No. 1 smog producer. In places like Beijing, where little environmental consideration is given to rapid growth, both industrial and vehicular pollution are major culprits.

Smog levels are quantified by several different measurements, but the single most important one is called PM 2.5. It stands for Particulate Matter (PM) suspended in air of a size less than 2.5 micrometers. These fine particles suspended like an aerosol are associated with heart disease, strokes, respiratory problems and premature death.

Although we still have a long way to go to improve our air quality here in the United States, it's not as bad as

it was 50 years ago, and it's not as bad as what's occurring now in other cities globally, which started me thinking about the impact of smog on turfgrass.

Most research exploring the impact of smog on turfgrass and plants was done during the 1950s, no doubt reflective of the time when smog and air quality were major concerns in the United States (and they still are).

The best summarization of the impact of smog or air pollution on turfgrass still is James B. Beard's book "Turfgrass: Science and Culture," published in 1973.

Smog symptoms do appear on turfgrasses in the form of an oily glazed appearance due in part to the degradation of chloroplast. Of the turfgrasses, *Poa annua* was found to be sensitive to air pollution and was used as a bioassay indicator in past studies.

Santa Ana, a hybrid bermudagrass released by the California Agricultural Experiment Station in 1966 (initial selection in 1956 at UCLA), in part was released because of its tolerance to smog.

Compared to Tifway and Tifgreen, Santa Ana exhibits a high tolerance to smog. Santa Ana is not widely used in the United States. However, in Australia it is still widely used on golf course fairways — not for its smog tolerance so much as for its salt tolerance and ability to retain color through late fall into winter.

On golf courses and other landscapes where smog is present, turfgrass suffers. And when we look more closely at the situation, it's clear to see that smog and the problems associated with it are overlooked contributors to the decline of turf.

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