Tour Events Played On Our Greens in 2011

Arnold Palmer Invitational
Bay Hill Club & Lodge
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March 24th-27th
Emerald greens planted 2009

Valero Texas Open
TPC San Antonio
San Antonio, Texas
April 14th-17th
CHAMPION greens planted 2009

Outback Steakhouse Pro-Am
TPC Tampa Bay
Lutz, Florida
April 15th-17th
CHAMPION greens planted 2009

St. Jude Classic
TPC Southwind
Memphis, Tennessee
June 9th-12th
CHAMPION greens planted 2004

Viking Classic
Annandale Golf Club
Madison, Mississippi
July 14th-17th
CHAMPION greens planted 2006

PGA Championship
Atlanta Athletic Club
Johns Creek, GA
August 11th-14th
CHAMPION greens planted 2009
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Navistar LPGA Classic
RTJ Golf Trail, Capitol Hill
Prattville, Alabama
September 15th-18th
CHAMPION greens planted 2011

Administaff Small Business Classic
Woodlands Country Club
Houston, Texas
October 7th-9th
CHAMPION greens planted 1996

AT&T Championship
TPC San Antonio
San Antonio, Texas
October 14th-16th
CHAMPION greens planted 2009

Sherwood LPGA Taiwan Championship
Sunrise Golf & Country Club
Taiwan, Republic of China
October 20th-23rd
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the WILT that wasn't

Turfgrass pathologists set the record straight on bacterial wilt.

Since it became a widespread nuisance at the Quail Hollow Club in Charlotte, N.C., the pathogen some call "bacterial wilt" has skyrocketed into the spotlight of turfgrass pathogens. It's become one of the Ten Most Wanted for golf course superintendents and turf researchers alike.

But those researchers still haven't even agreed on what it actually is. Though they sometimes disagree on findings, this pathogen has split some labs into camps.

DOES IT EXIST? "Bacterial wilt is a real disease," says Dr. Lane Tredway, senior technical field representative for Syngenta. "It's a documented disease on annual bluegrass caused by the bacteria *Xanthomonas translucens*. The same bacteria was implicated in the cause of the widespread decline of Toronto creeping bentgrass in the early 80s. What we're seeing today may or may not be related to that."

Tredway, who headed the North Carolina State Turf Pathology program before recently joining Syngenta, says researchers are moving too fast when categorizing the pathogen.

"I think the mistake we're making is we're trying to put the story to rest too quickly," he says. "It's way too early to make any definitive conclusions as to how important these bacteria are, how widely distributed they are and, most importantly, how to diagnose them and manage them."

But even at these early stages, the name doesn't quite fit, says Dr. Rick Latin, professor of plant pathology at Purdue University.

"I'm not even sure I can call it bacterial wilt," he says. "Bacterial wilt was identified as *Xanthomonas*, but here's the issue: On creeping bentgrass, it's caused by *Acidovorax*. They're widely different pathogens and different species, so why would we call it the same thing?"

Latin refers to the disease as "bacterial decline," differing from the original "wilt" and from the "bacterial etiolation" that Michigan State University's Dr. Joe Vargas uses.

With any name, there's no question that bacteria are involved. Turfgrass pathologists disagree on which is to blame, or how many could be. Vargas says the cause is *Acidovorax avenae pv avenae*, which he found in infected samples. But more important than the pathogen's name is what it does to turf itself, and that can be backed up by observations.

"Where we have to start is with the symptoms," says Dr. Nathanial Mitkowski, associate professor of plant pathology at the University of Rhode Island. "The thing we know for a fact, that is undisputable, is that it seems to occur on creeping bentgrass greens. The symptoms include etiolation, thinning, typically shallow rooting and yellowing."

Etiolation, or a general yellowing and elongation of the plant, plays a big part within that list of symptoms. The pathogen can strike anywhere there's creeping bentgrass, but the symptoms tend to be more severe in areas with more heat.

"In cooler climates, these symptoms may pop up for a week or two weeks in August or July, and then it'll recover and go away, and you won't see it again until next year," says Mitkowski. "In warmer climates, like the Southeast, the symptoms may pop up as early as April or May. They're obviously worse when you get to June or July, but they can go for months, through the height of the growing season."

Though researchers have had the pathogen on their radar for much longer, it's really only exploded onto the scene within the past two to three years, says Mitkowski. That growth coincides with two of the toughest summers on record for many golf courses, a correlation that isn't lost on researchers.

"It's first important to keep in mind that the last two summers have been extremely difficult from an environmental standpoint for golf course superintendents with persistent heat and, in some areas, prolonged drought conditions," says Tredway.

According to Vargas, the damage comes from bacteria preventing turf from getting the necessary water for growth, especially during these heat-stressed times.

"We have ... found xylem vessels clogged with bacterium," says Vargas. "Xylem vessels conduct water from the roots up to the shoots. Clogged xylem vessels which limit the uptake of water, especially during warm weather of the summer, put the creeping bentgrass plants under tremendous stress and can result in their death."

But the list of symptoms is almost the only thing on which researchers working on the pathogen can mostly agree. Only a few labs in the country are prepared to identify samples of the bacteria involved, and currently, the results are contested.

THE BATTLE FOR THE BACTERIA. Originally, the symptoms, including etiolation, were believed to be caused by a connection to applications of Primo to creeping bentgrass. As more research was completed, more clues about the pathogen came into focus, shifting away from that explanation alone. When Vargas found *Acidovorax* under an electron microscope, he named it as the primary pathogen involved.

"We have isolated *Acidovorax* into pure culture and inoculated healthy creeping bentgrass plants, placed them in growth chambers and we were able to infect the plants with *Acidovorax* showing it is a pathogen capable of attacking creeping bentgrass," says Vargas.

But finding it capable of attacking the turf isn't the same as actually finding the cause of the symptoms until testing can duplicate those findings. Turfgrass researchers check those results against Koch's postulates to determine whether something involved is a pathogen.

"You have to isolate it from where you found it, and then you have to put it back on a new plant and determine that you get the same symptoms," says Mitkowski. "We're talking about the proof of concept. Yes, this thing causes disease when we put it on uninfected grass. And Vargas did that, with some stipulations.

"This bacteria he found was a pathogen, but it didn't produce the exact same symptoms that we saw in the field. In the greenhouse, sometimes it would just kill the grass. Sometimes it would just do a little bit of damage and knock out some of the leaf blades and the plants would recover. This is really where all the controversy is, though. It's a known bac-

KEY POINTS:

- The cause of the symptoms associated with "bacterial wilt" is still being researched by turfgrass pathologists.
- The bacteria *Acidovorax* has been found in much affected turf, but other factors are still being determined.
- Stress caused by harsh summer weather and aggressive management practices could be a factor in the appearance of symptoms.
- Turfgrass pathologists are currently testing field applications to find effective responses to the symptoms.

Superintendents with creeping bentgrass have seen symptoms of etiolation, thinning, yellowing and shallow rooting.

terial pathogen in other plants, but it is not producing the same symptoms we see in the field."

Whether or not it definitively meets that standard, Vargas sees the bacteria producing results similarly in the greenhouse tests.

"Some of these infected plants were also examined under the electron microscope and again the xylem vessels were clogged with *Acidovorax*," says Vargas.

The concept of the bacteria as the primary pathogen is also supported by some testing that shows results with application of an antibiotic to the turf (though these products aren't currently legally allowed to be used for turf outside of experimental testing). When it's been done experimentally, according to Mitkowski, the symptoms go away.

Even if bacteria is to blame for the symptoms, the disparity between what's observed in the field and in the greenhouse means there's another piece to the puzzle, says Tredway.

"There are a lot of possibilities," he says. "There are bacteria that are known to induce these types of symptoms. There are fungi that cause etiolation in other crops. We've investigated the bacteria possibilities very heavily, and the problem is we cannot find any one particular bacteria that is consistently associated with these symptoms. We do find *Acidovorax* associated with the etiolated turf in a number of circumstances, but there are other occasions where we've not been able to find that particular bacteria and instead we find two or three others."

Though there are other possibilities, *Acidovorax* is still a major player for Mitkowski.

"From my perspective, whenever I get samples of this etiolation, of this thing we call 'bacterial wilt,' I'd say 99.9 percent of the time I find this bacteria that Joe Vargas identified," he says. "So that's some empirical evidence, but it's not experimental evidence."

Vargas found the Acidovorax bacteria in affected bentgrass.

WHAT'S MISSING? "I definitely think it's reasonable to assume there's *Acidovorax* involved here," says Latin. "But whether or not the *Acidovorax* is

Fighting the unknown

While research into the causes of the symptoms associated with "bacterial wilt" is ongoing, affected superintendents deal with the problem every day. Dr. Lane Tredway, senior technical field representative for Syngenta, reports some curative activity from Signature and Daconil Action, or copper-containing compounds – however, "none of these treatments are what we would call effective," he says.

Another approach involves a focus on basic agronomic practices, says Dr. Rick Latin, professor of plant pathology at Purdue University.

"Do all of the agronomic practices to promote healthy root systems and vigorous turf, avoiding cultural stress during the summer wherever you possibly can," says Latin. "That might mean backing off the aggressive grooming, raising the mowing height and working in some rolling."

Keeping fans on turf to keep surfaces cool and dry and preventing nitrogen stress will also help plants navigate tough summer weather, he says.

Cultural practices aren't definitive cures, but they do get results, says Dr. Nathanial Mitkowski, associate professor of plant pathology at the University of Rhode Island.

"To date, those are the approaches that have been most effective," he says. "People who have gone at it culturally have made some real strides in mitigating the disease."

But the top tip Latin has for handling those symptoms is communication with the course's membership.

"I think memberships by and large are understanding these things happen," he says. "Right now I think there's all kinds of information out there and all kinds of opinions. If I were a superintendent, I would say, 'The first thing we want to do because nobody really knows whether this disease is a *bona fide* pathogen or the consequence of predisposing factors, let's go back to our basic agronomy and try to relieve as much stress as possible.'"

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Taking sides

The academic discussion surrounding the "bacterial wilt" pathogen has created controversy between turf pathologists. It's also left some superintendents feeling uneasy acting on advice when researchers can't agree on a cause for the symptoms.

It's additionally tough because the debate hasn't created many alternatives to proposed responses so far, says Mitkowski.

"It does appear that there's something we're missing, but we don't know what it is," he says. "So far, no one has been able to say, 'You think it's this, but we say it's that.' There's just been a lot of 'You think it's this, but we think you're wrong.' That's frustrating because there's no alternative hypothesis for what's causing the problem."

From outside the labs, it may sound like a more personal controversy, but the basis lies in exploring possible explanations and finding the correct diagnosis, even if the answer isn't immediate.

"It's just important to keep in mind that these things take time and they take money," says Tredway.

It's also not the first time in the history of treating turfgrass disease that a difference of opinion has led to arguments between researchers – and given reason to continue looking into other ideas.

"Doubt is not a bad thing," says Mitkowski. "It's just no one has been able to provide and substantiate any kind of alternate hypothesis. I'm not wedded to this bacteria. If someone can show me some experimental proof that it's something else or there's something else involved and it's good data, that's fine. I'm just trying to solve a problem, here."

the aggressive primary pathogen that brown patch or pythium is? I would say no."

Research into what role the bacteria (or another agent) plays in creating these symptoms is ongoing, but a few issues make study in the greenhouse difficult.

"It's virtually impossible to mimic the stress and the conditions on a golf course putting green in a growth chamber environment," says Tredway. "Even though we have control of the temperature, humidity and lights, we can't do the close mowing and apply a lot of the stresses that a golf course superintendent does."

That's a problem for Mitkowski, as the most heavily affected turf he sees on courses is under multiple stresses.

"It may be the stress involved in a golf course," he says. "They've got constant management; they've got lots of different fertilizers going on. When I go out to golf courses, almost always the bacterial wilt symptoms are occurring on the plants that are in the worst conditions: there's too much shade, it's too wet, there's too much traffic."

That stress is a possible missing piece, according to Latin – he argues there's another factor that predisposes turf to infection by *Acidovorax*. As his research has continued, he's observed high concentrations of the bacteria are required in turf to get some symptom expressions.

"Of course, you don't need those types of populations when you're wounding plants and likely introducing bacteria when we mow every day," he says. "We've

had two very stressful summers here in the Midwest, and that's when the reports starting coming in."

Stress could be a factor, but it's not the only possibility, according to Mitkowski.

"The other explanation is there's something else going on in the field that we're missing in the greenhouse," he says. "There's a chemical that's been applied, there's been some suggestion that certain plant growth regulators or biostimulants that golf course superintendents use which aren't being applied in the greenhouse are actually stimulating the bacteria to cause disease.

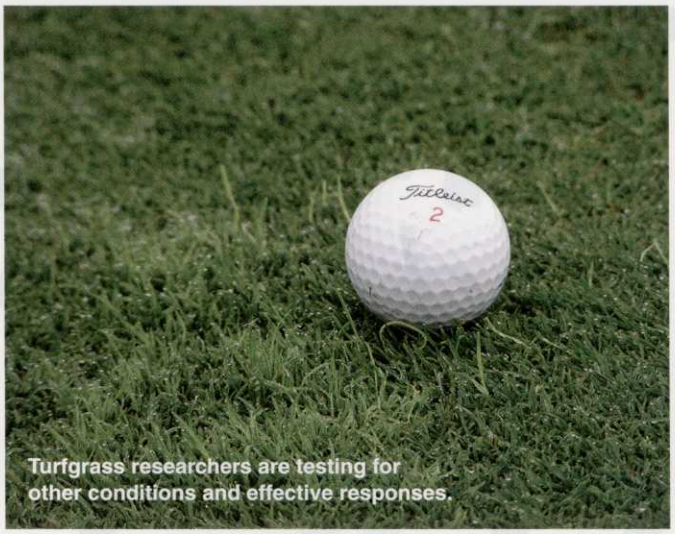
"It's possible that there is another agent – that this isn't one bacteria causing this disease and the bacteria is one piece of a multipiece complex."

The question remains, but probably not for much longer. As more research is being done by the labs equipped to handle identifying the bacteria, researchers are actively testing in the field, where other possible conditions can be observed and applications tested.

"Hopefully, by the end of the summer, we'll be able to say, 'These are the applications we made that worked, these are the applications that had no effect and these are the applications that made it worse,'" says Mitkowski.

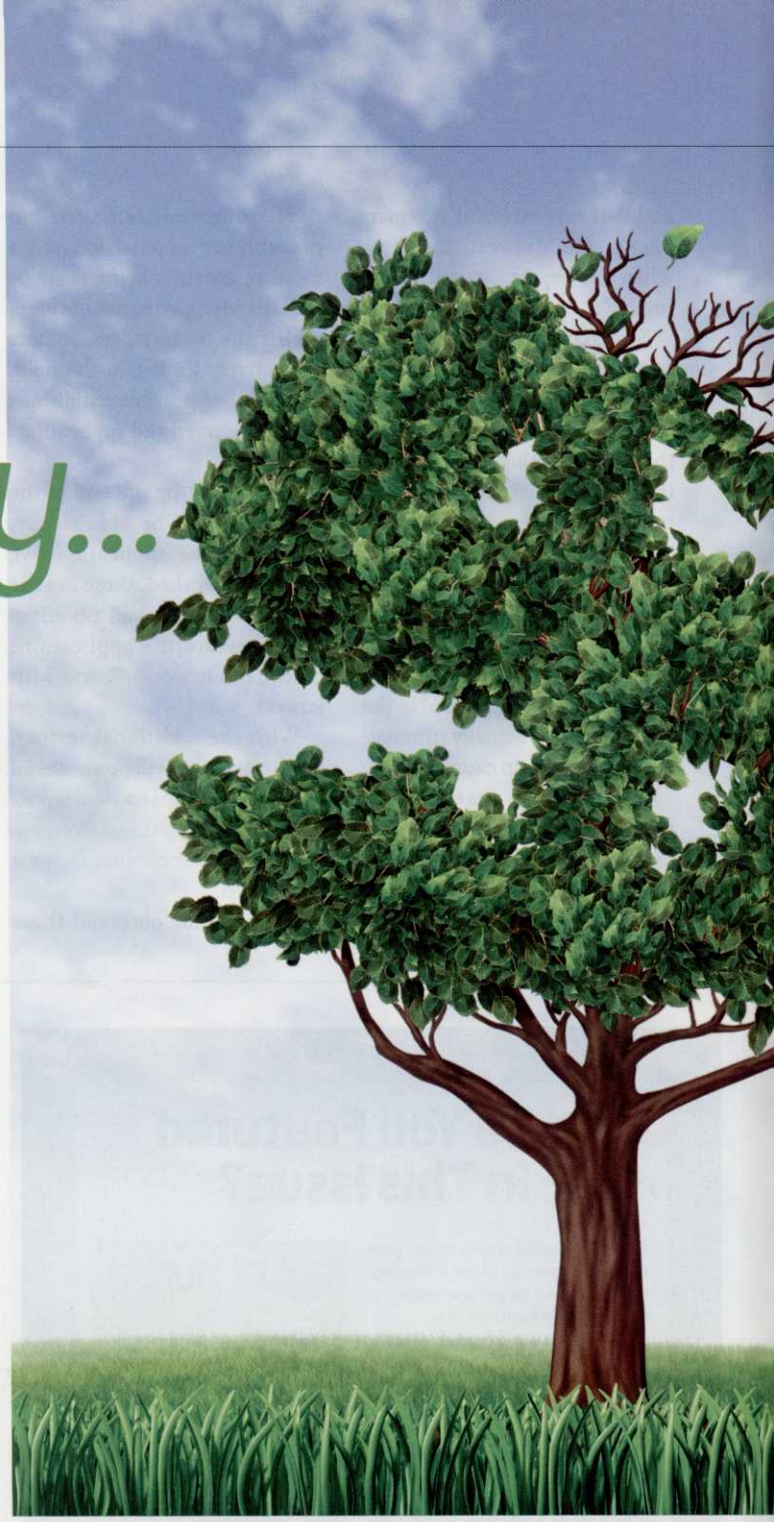
With the additional testing, more questions will be answered –whether it means *Acidovorax* will remain a top threat to creeping bluegrass or another factor is implicated.

"No one has observed these symptoms, isolated the bacteria in pure culture and put them back and recreated those symptoms in the field," says Latin. "Once we're able to do that, I think we're going to learn a lot more about this particular pathogen and the extent to which this bacteria is a pathogen. **GCI**


Turfgrass researchers are testing for other conditions and effective responses.

Kyle Brown is GCI's associate editor.

TIME... *and money...* FLIES



As you approach the later years of your career it's prudent to evaluate and prepare for life's final act.

by Bruce R. Williams, CGCS

Sometimes it takes the loss of a loved one or friend for any of us to understand the harsh reality that we won't live forever. Unfortunately, most of us would like to believe we will live forever and there is no real need to get our house in order. Often we see families left in disarray due to a lack of planning.

There is no exact age for retirement these days, but suffice it to say 65 is no longer an exact number for most to retire. As we all approach the later years of our careers it is a good thing to evaluate the next steps of our lives.

I'd like to share the sage advice passed on to me by my parents, estate planners and financial planners. First, I need to clarify that I am neither a financial planner nor a lawyer, so my comments are from a former golf course superintendent who has learned a few valuable lessons along the way. I strongly advise everyone utilize the proper professionals who can help you plan ahead to prepare for retirement and to provide for your family after you pass on.

PLANNING AHEAD. This advice isn't just for the geriatric crowd. In fact, planning should start as soon as any of us take on the responsibility of a family. A plan developed 30 years ago will need some adjustments over time, but the core plan should serve you well most of your life.

Experts say it will take about 60-80 percent of your current income to maintain your employed lifestyle after retirement. Unless you win the lottery, this requires a lot of saving and wise 401(k) investments or other retirement vehicle.

The recent recession reduced a lot of people's net worth and this will likely create unforeseen financial issues. Adjustments may include downsizing your house, working longer and taking a long hard look at a reasonable budget you can live with on a fixed income.

HAVE YOU PREPARED FINANCIALLY? There are a variety of tools out there today than can help you plan for retirement. All one has to do is conduct an Internet search for a retirement calculator and a variety of websites will show up. These are great generalized tools to assist you in planning. Numbers will still need interpretation, as there are so many factors involved in retirement planning and family support.

Previous generations have depended upon Social Security as a significant component of retirement income. While there are debates as to whether Social Security will be there in the future we have to deal with the system as we know it today. Every few years we receive information about the likely amount we

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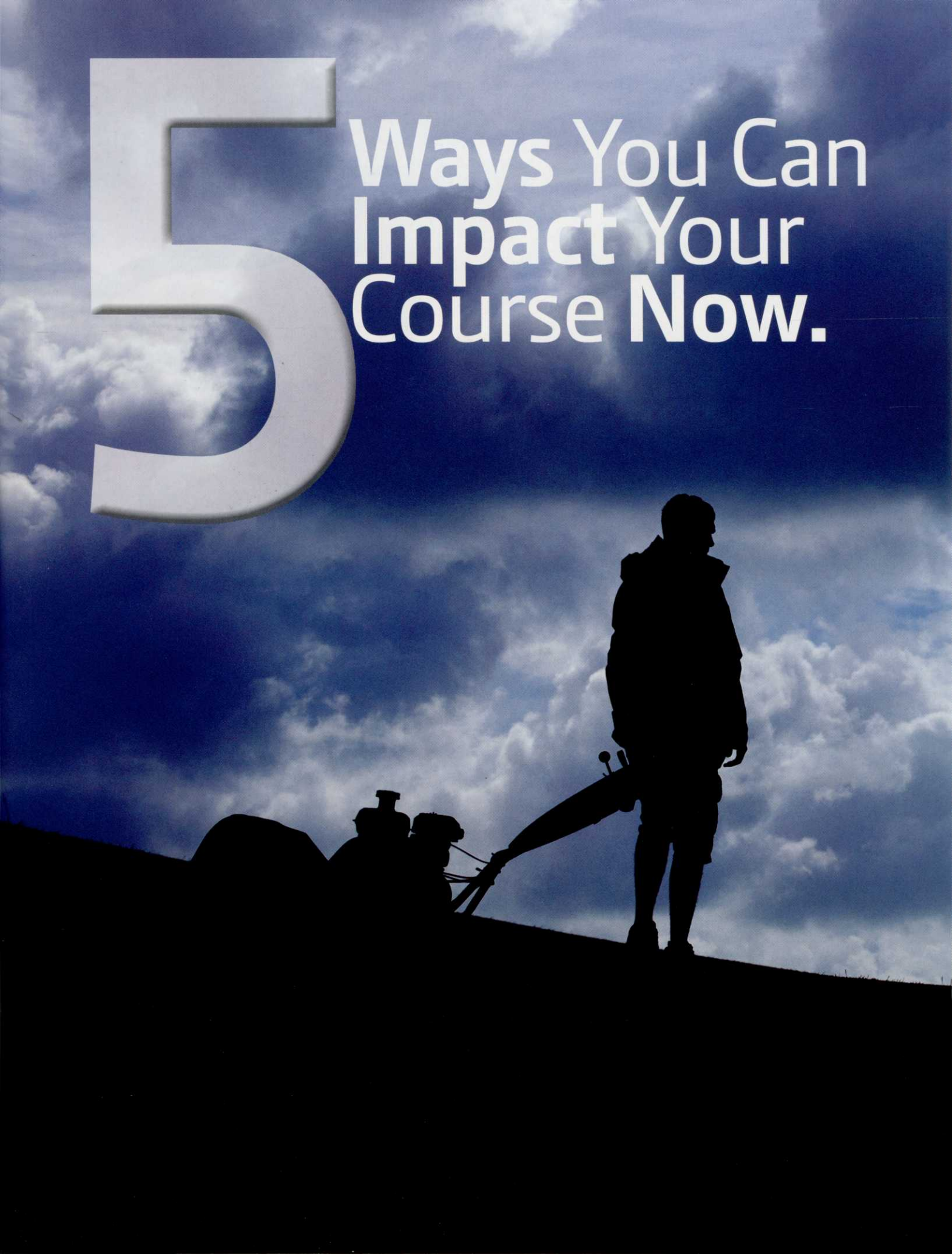
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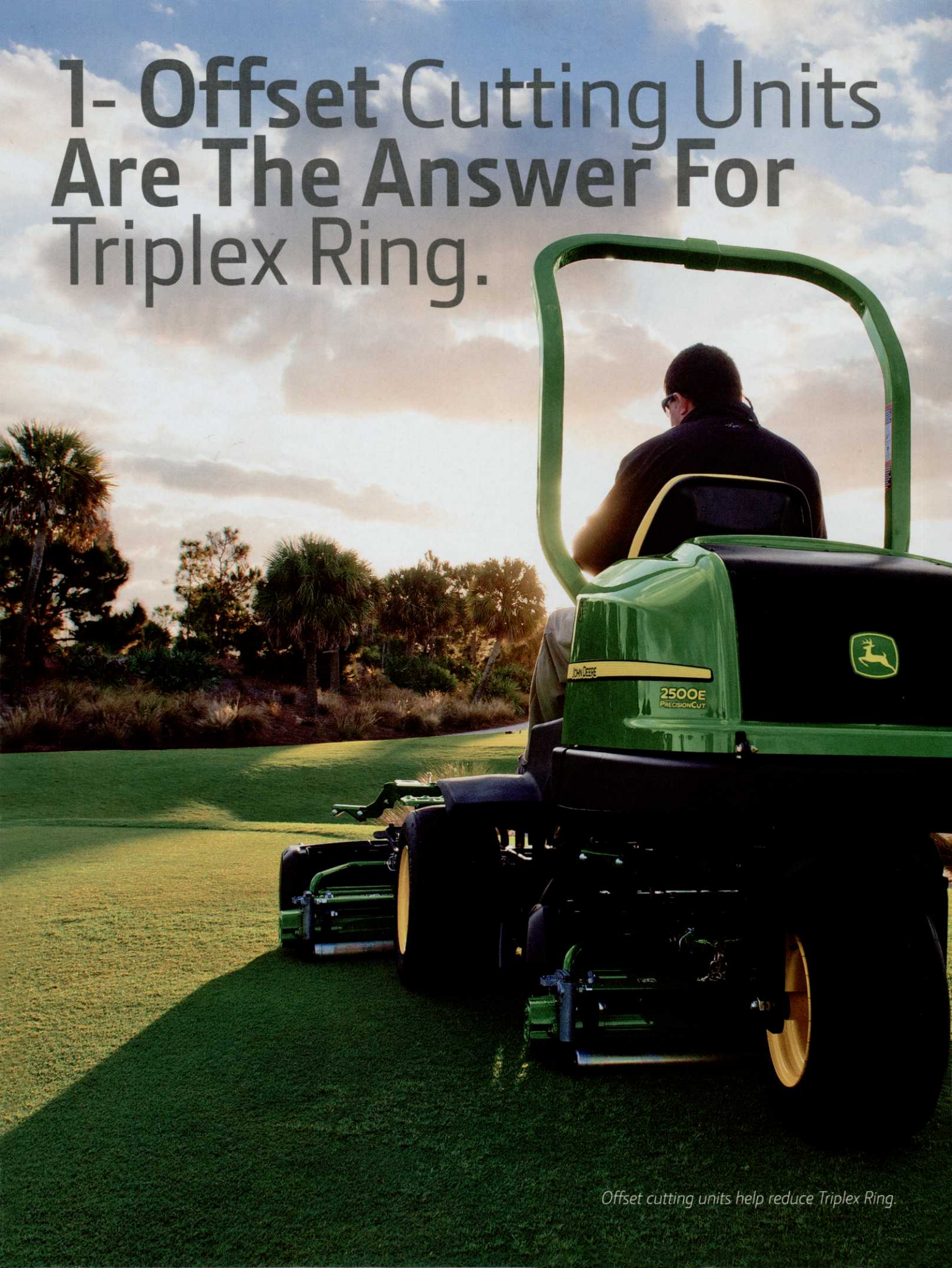

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