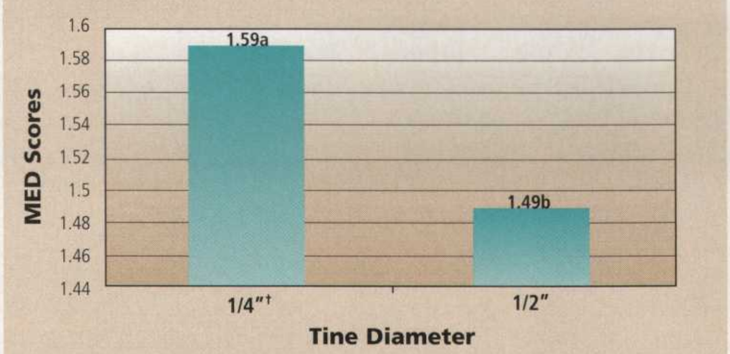
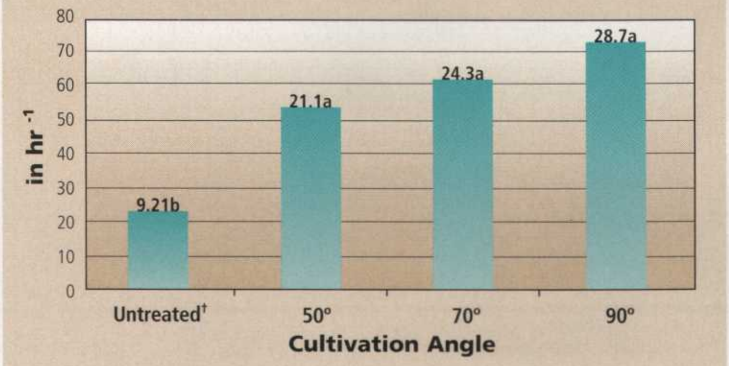
FIGURE 2



Molarity of ethanol droplet test results of Crenshaw creeping bentgrass affected by quarter-inch- and half-inch-diameter tines, pooled across the 50-degree, 70-degree and 90-degree core cultivation tine entry angles, plus an untreated plot (without cultivation).

†Mean data points followed by the same letter are not significantly different at P≤0.01 by protected LSD.

FIGURE 3



Water infiltration rates of Crenshaw creeping bentgrass affected by 50-degree, 70-degree and 90-degree core cultivation tine entry angles plus an untreated plot (without cultivation) pooled across the quarter-inch and half-inch tines.

†Mean data points followed by the same letter are not significantly different at P≤0.01 by protected LSD.

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placed on each soil sample using a pipette.

A scale of 1 to 4, based on the molarity of the ethanol solution tested, was used with 4 being severely hydrophobic (repel water) and 1 being hydrophilic (water loving). If the entire droplet did not completely infiltrate the soil sample within five seconds, the next highest molarity of ethanol/distilled water was applied adjacent to the initial drop until the entire droplet was fully absorbed by the soil sample. Soil hydrophobicity increases as the molarity ethanol/distilled water solution increases, until the droplet completely infiltrates the soil sample within five seconds.

Water infiltration analysis was performed in November following yearly cultivation treatments using a double-ring infiltrometer (model 13a, Turf-Tec International). One sample was taken per plot. The outer ring had a diameter of 4.5 inches and the inner ring 2.5 inches. The infiltrometer was inserted into the turf at a 2-inch depth. Rings were then filled to the top of the infiltrometer (4 inches) with water. After water vacated the center ring, infiltration rates were recorded based on how long the water took to absorb fully into the soil.

Treatments were arranged in a randomized complete block design. All main effects and interaction effects were evaluated using analysis of variance within the Statistical Analysis System (SAS Institute, 2003).

Main effect means for TQ, MED and water infiltration rates are reported because month, treatment and tine size interactions were not significant. Means separation was analyzed using Fisher's LSD test with an alpha of 0.10.

Turf quality

There were no cultivation treatment effects in year I for TQ. However, in year II, the 70-degree tine entry angle provided minimal TQ enhancement (6.4) compared to the control (6.1) (Table 1).

As expected, TQ declined in August (<6) because of summer stress. However, the bentgrass green recovered in September (6.7), when temperatures were moderate. Turfgrass quality declined in October (5.9) because of an outbreak of dollar spot (*Sclerotinia homeocarpa* F.T. Bennett) initiated by high humidity, warm days and cool nights (Belanger et al., 2004), which are typical environmental conditions in the transition zone in late September/early October.

Tine entry angle did not affect MED results; however, the smaller tine diameter (quarter-inch) increased MED 7 percent compared to the half-inch diameter tine (Fig. 2).

Localized dry spots can occur when water infiltration in certain areas is reduced. Use of larger tine diameters, which impact a greater amount of surface area than smaller tine diameters, may possibly reduce LDS's and soil hydrophobicity. Therefore, it may be more beneficial for a superintendent to use a larger tine diameter on a sand-based putting green to minimize unwanted dry patches of turf.

Water infiltration

No water infiltration differences because of tine entry angle were measured for any core cultivated plots. However, without cultivation, water infiltration was reduced 129 percent, 163 percent and 211 percent compared to the 50-, 70- and 90-degree treatments, respectively (Fig. 3).

The decrease in water infiltration is probably indicative of excessive thatch accumulation. These data indicate the importance of aerification to superintendents who manage sand-based creeping bentgrass putting green surfaces. Thatch accumulation is often accelerated in creeping bentgrass cultivars because of their aggressive horizontal growth habits and limited vertical growth, which may quickly develop into thatch in the absence of cultivation.

In another study, McCarty et al. (2005) noted a 188 percent greater infiltration rate with cultivation treatments compared to untreated plots on a sand-based creeping bentgrass putting green.

Conclusions

Based on results, different core cultivation tine entry angles had minimal statistically significant impacts on parameters measured. However, while not significant, differences were detected between the different angled tines, which may prove to be practical differences for turfgrass managers.

An interesting follow-up study would be to investigate the impacts of different tine entry angles on fine-textured soils (high clay content), which are more prone to compaction.

Finally, deeper tines with different diameters of similar tine entry angles into the soil profile may provide more beneficial results.

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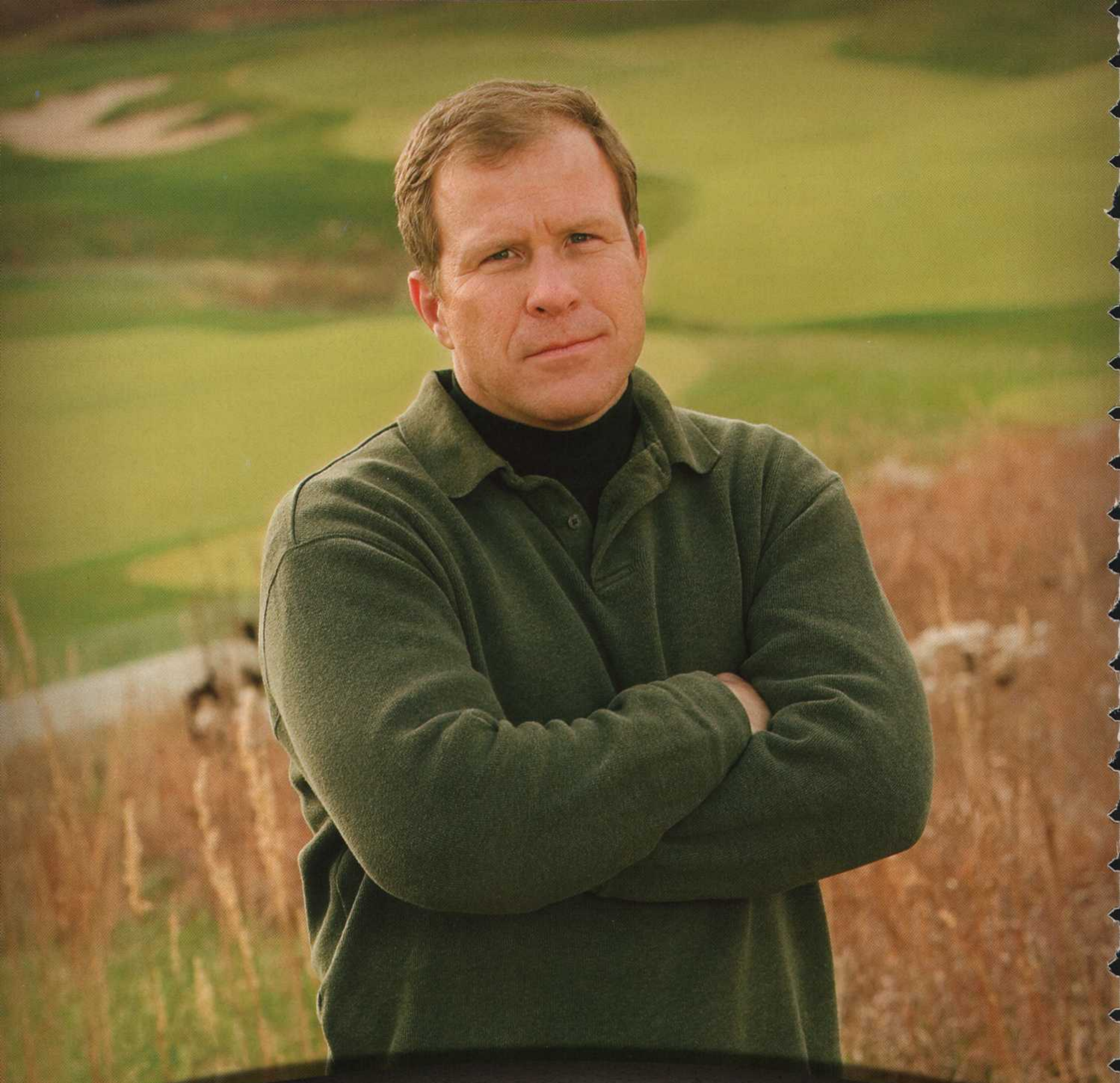

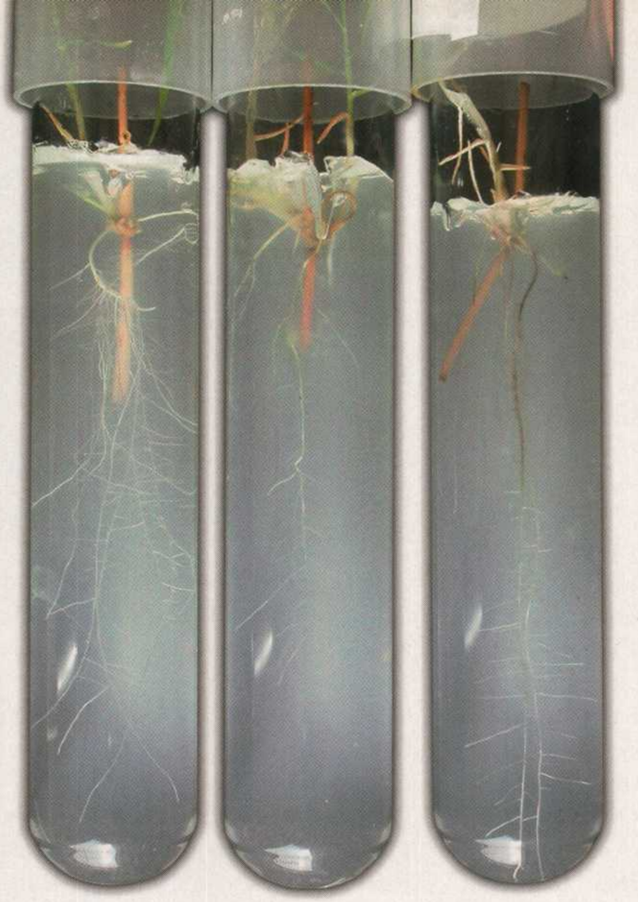

RESEARCH ALIVE FOR

Spring Dead Spot

Oklahoma State researchers make breakthrough on how to treat troubling turf disease

By Anthony Pioppi, CONTRIBUTING EDITOR

Recent findings made public by research at Oklahoma State University may shed light on a disease that has frustrated superintendents and turfgrass researchers since well before it was first identified in the early 1960s.

Spring dead spot is the rue of virtually every superintendent in the transition zone who manages bermudagrass where winter temperatures sustain below-freezing levels. Other than a ridiculously expensive preventive spray program — anywhere from $30,000 to $50,000 for two applications — there is little that can be done to thwart or even manage the pathogen.

That may change, however. Nathan Walker, an assistant professor at Oklahoma State University and one of the leading researchers on spring dead spot, said he and others in the department have uncovered an interesting trait of the disease, namely that it is much more active in the spring than imagined. Preventive spraying has traditionally been done in the fall prior to the first freezing temperatures and that time of year has always been the focus of research, Walker said. Now he and others at OSU believe the soil-borne disease is more active in the spring, and dealing with it then may have positive results.

Research on the seasonal activity of the pathogen began in 2000, so the findings are preliminary. Walker admits the findings have not been challenged by the scientific community at large yet he is confident enough in the research to have presented the results to a group of turf pathologists last October.

Although nearly half of the United States has summer temperatures warm enough to grow bermudagrass, only areas with temperatures cold enough to send the turf into complete dormancy are affected.

In the spring, circular areas of infected turf, varying in size from a soup can lid to the hood of a car, turn brown and die. The areas only recover when healthy turf moves back in as the disease recedes in the summer months. Since the disease is soil-borne, the problem returns to exactly the same areas every spring. If the affected area is small enough, the turf and soil can be removed using a cup cutter or similar tool.

Even though spring dead spot was first identified in the early 1960s, superintendents and turf researchers differ about some traits of the disease. Many superintendents say pH of the

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Spring Dead Spot

Since spring dead spot is a soil-borne disease, it returns to the same area every spring.

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soil affects the disease, but pathologists and others disagree. The two sides also disagree on the susceptibility of turf varieties. Superintendents such as Brian Peterson will tell you older common varieties withstand the onslaught better than newer ones.

Peterson has been the superintendent at The Greens Golf and Racquet Club in Oklahoma City since 2004. The course was built in the 1970s and has common bermudagrass. He said spring dead spot there is manageable. But when Peterson was at Gaillardia Golf Country Club, also in Oklahoma City, he was virtually helpless as the disease decimated large areas of fairways and roughs on a course less than 15 years old. The Arthur Hills design hosted the 2001 and 2002 Senior PGA Tour Championship.

"At Gaillardia, it just kicked my butt," Peterson said, describing the annual scene looking as if somebody sprayed large swatches of the course with Roundup.

Peterson said there was little he could do and spraying out was out of the question, even at such a high-end facility.

Walker and others say the theory that common varieties hold up better is not based on fact. He surmises that turf on older courses has built up resistance over time and is not inherently better at holding off spring dead spot than newer cultivars.

He did point out that OSU breeders have developed varieties such as Riviera and Patriot with resistant qualities.

Many of the newer varieties developed by other sources do not have the resistance and are marketed to areas of the country not affected by the disease, he said.

"Some of the new grasses have been developed while not taking spring dead spot into mind," Walker said.

Researchers and superintendents do agree that spring aeration helps combat the disease.

"Any disruption of the soil tends to disturb the disease," Walker said.

Superintendent Roby Robertson of Shangri-La Resort in Afton, in the northeast corner of Oklahoma, deals with two varieties of the disease at his course and has found raising the height of cut in the fall on all areas of turf helps minimize the affected areas come spring.

The length of the winter freeze may be the biggest factor in determining the severity of the disease.

In Chattanooga, Tenn., and the surrounding area, spring dead spot appears with much less severity than in Oklahoma City, almost on the same latitude.

Black Creek Country Club superintendent Scott Wicker says the disease hits throughout his course but is gone by July 4. Even when he was superintendent at nearby Lookout Mountain Golf Course, at an elevation of more than 2,100 feet, the disease was not a top priority.

"We don't get the Arctic winds out of Canada in the winter," he said.

According to Wicker, the largest affected areas are not more than 2 feet in diameter.

Because of the cost of spraying and its limited effectiveness, he elects not to go that route but would in different circumstances.

"If there was something out there that worked, it would be used here," he said.

Peterson has a theory on why an affordable chemical has not made its way into the market. He says that measures to stem the disease would have been developed years ago if spring dead spot had affected another variety of turf in another region of the country.

"If all of this happened in New Jersey, there would be a 400-member task force from 12 universities working 24/7 to fix it," he said. ■

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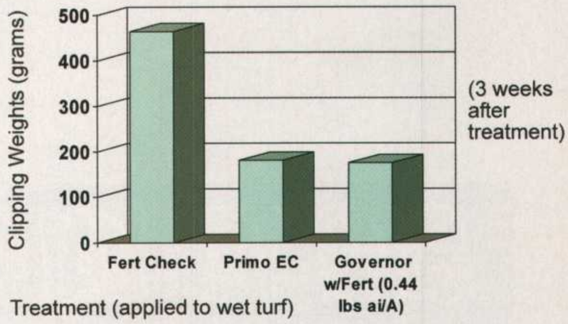

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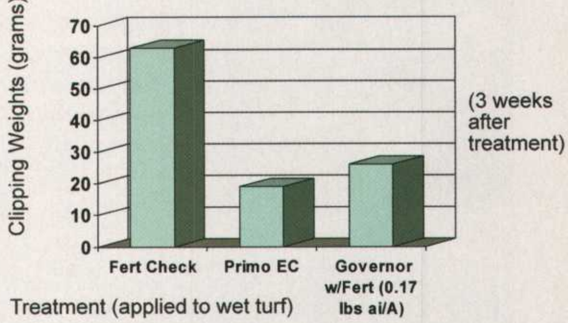

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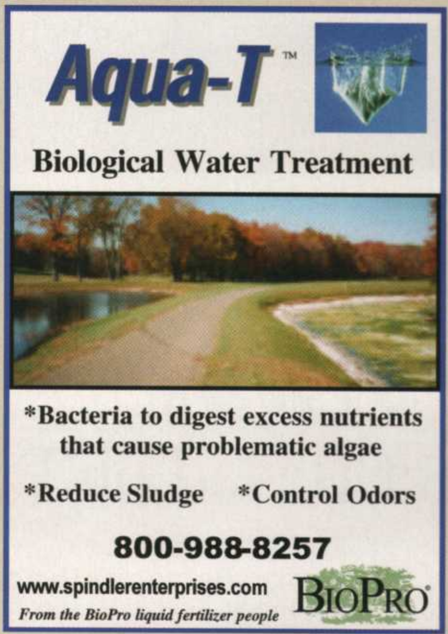
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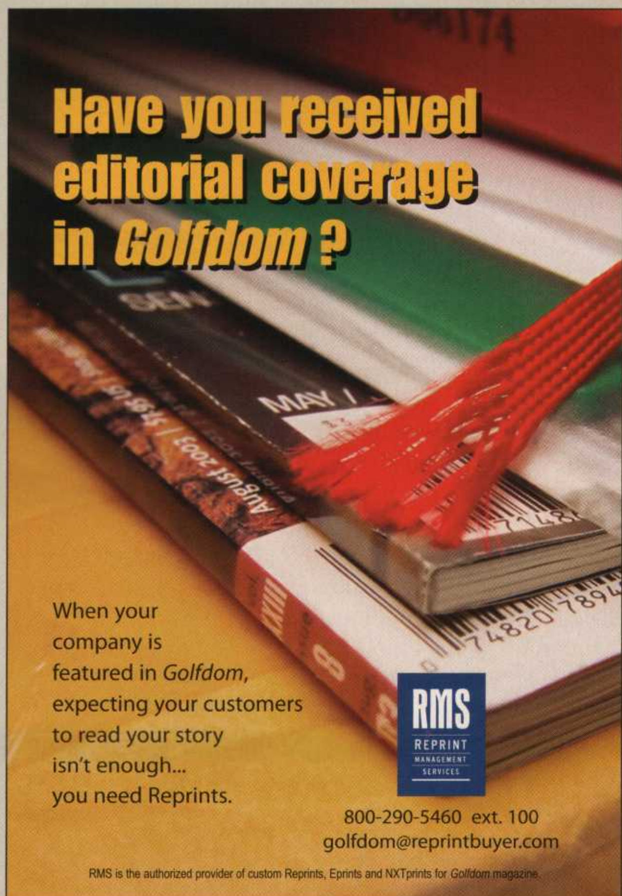
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