TURFGRASS TRENDS

PYTHIUM ROOT DYSFUNCTION

P.volutum Can be the Cause for *Pythium* Root Dysfunction

By J.P. Kerns and L.P. Tredway

Since 2002, many golf course superintendents in the southeastern United States have reported unusual patches appearing on their creeping bentgrass greens. Symptoms appeared during the heat of summer in irregular patches ranging from 6 inches to 12 inches in diameter. Grass in affected areas was initially wilted and chlorotic, but later exhibited a yellow to orange foliar decline. The patches resemble the stand symptoms of take-all patch (Figure 1), and microscopic examination of affected tissue revealed necrotic crowns, which is another symptom of take-all patch.

As a result, many pathologists, ourselves included, diagnosed the problem as take-all patch. Yet, the fungicides typically used for take-all patch were not effective against the disease. Furthermore, isolations revealed that the take-all pathogen was not present in the affected areas.

It was not until the fall of 2003 and spring of 2004 that we discovered another pathogen in the infected root tissue. During this period of unseasonably hot, dry weather, we found an abundance of *Pythium* hyphae, oospores, and sporangia (Figure 2) in the root tissue. Furthermore, examination of affected root tissue revealed bulbous root tips, loose cortical structure, and an absence of root hairs (Figure 3). To our fortune, we found two papers by Clinton Hodges at Iowa State published in the mid-1980s that described very similar symptoms. Hodges observed that two *Pythium* species, *P. aristosporum* and *P. arrhenomanes*, were associated with irregular patches and roots that were tan-colored, devoid

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FIGURE 1

This advanced Pythium root dysfunction on A-1 bentgrass can be misdiagnosed as a patch in early onset.

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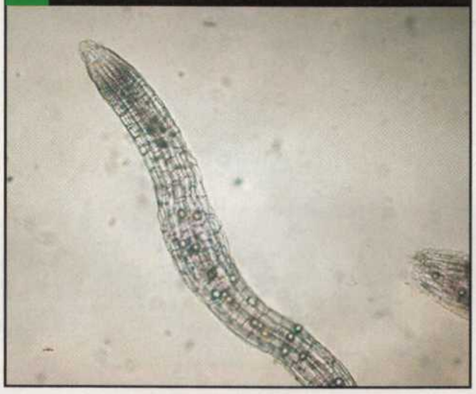
FIGURE 2



Pythium hyphae and oospores in creeping bentgrass roots that are associated with Pythium root dysfunction patches.

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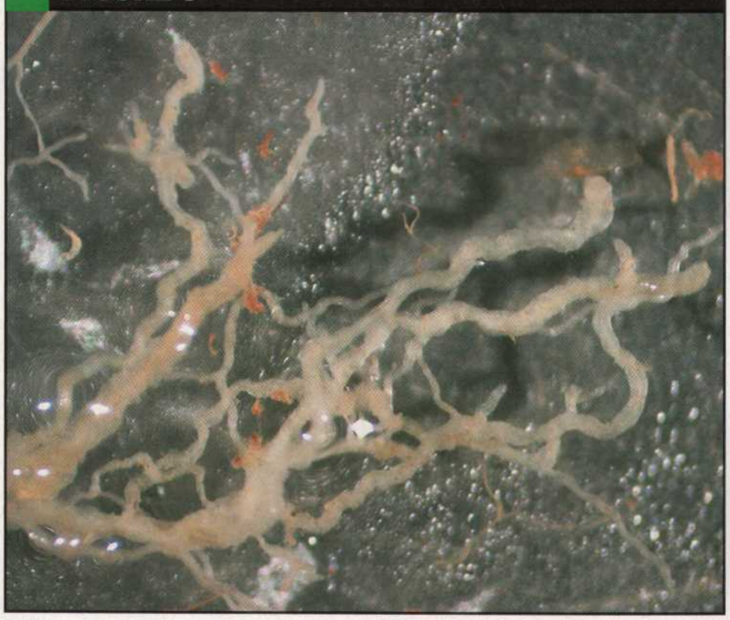
of root hairs, lacked cortical structure, and possessed dead bulbous root tips. Hodges coined the disease *Pythium* root dysfunction (PRD) because there was no apparent rotting of the roots, and the root tissue was not functioning properly.

Pythium root dysfunction also was observed by Feng and Dernoeden in Maryland in 1999. They collected 28 isolates from 109 putting green samples exhibiting symptoms of *Pythium* root dysfunction and identified eight different *Pythium* species. The researchers concluded that *P. aristosporum* was the most important causal agent of PRD based on frequency of isolation and aggressiveness toward creeping bentgrass seedlings. Following these accounts of PRD, little work has been conducted on this disease. Therefore, very little is known about the etiology, epidemiology and management of PRD. Our work at North Carolina State University has focused on the etiology and epidemiology of PRD in order to develop effective management strategies for superintendents.

FIGURE 3



When creeping bentgrass roots are infected with Pythium volutum, the roots lack root hairs, have bulbous root tips and have a mild, tan color.

Etiology of *Pythium* root dysfunction

Since 2003, 80 isolates of *Pythium* have been collected from 14 golf courses in North Carolina, South Carolina, and Virginia. In 2004, we began identifying our isolates using morphological and molecular techniques to determine the *Pythium* species responsible for PRD. Of the 80 isolates obtained, 58 were identified as *P. volutum*; 16 were identified as *P. torulosum*, and the remaining six were *Fusarium*, *Curvularia*, or *Coprinus* species. *Pythium volutum* was the dominant species, isolated from 13 of 14 locations, whereas *P. torulosum* was only isolated from five of the 14 golf courses sampled.

Pathogenicity of these species was determined by inoculating mature A-1 creeping bentgrass plants with one of five isolates of *P. volutum*, two isolates of *P. torulosum* and a combination of the two species. Inoculated plants were incubated for four weeks at 75 degrees Fahrenheit/61 F (day/night) to permit root infection, followed by a heat stress period at 90 F/79 F to induce foliar symptoms. Typical foliar symptoms developed two weeks after raising the temperature to 90 F/79 F. All isolates of *P. volutum* were highly aggressive on creeping bentgrass roots (70 percent to 100 percent disease severity)

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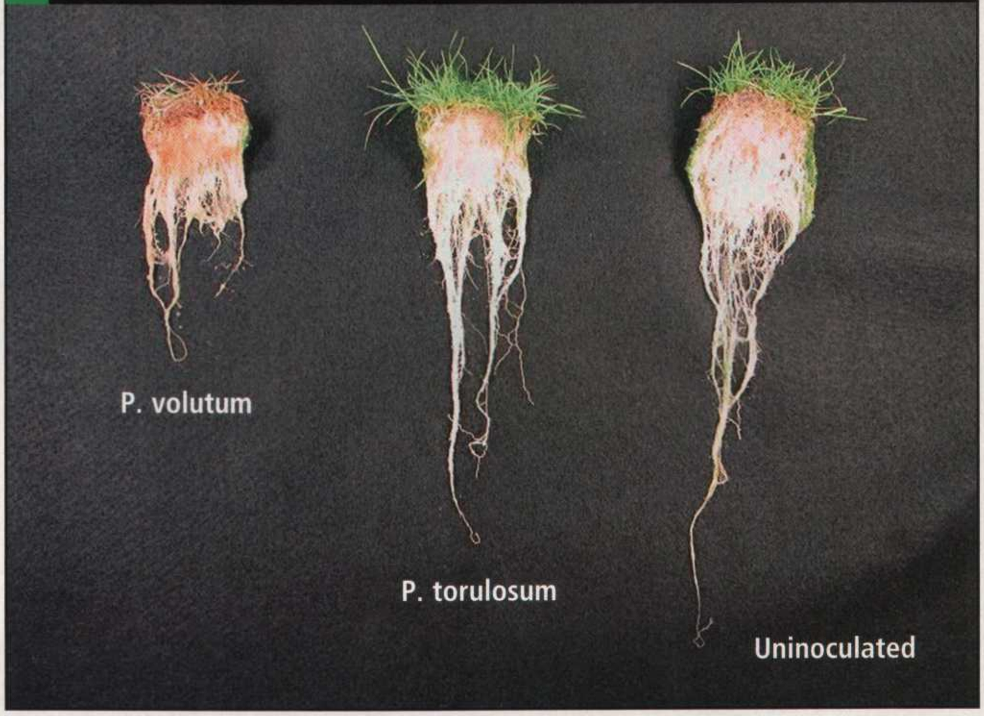
FIGURE 4



Creeping bentgrass root depth with Pythium volutum infections are significantly shallower compared to Pythium torulosum and an uninoculated control specimen.

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compared to isolates of *P. torulosum*, which caused only 10 percent to 20 percent disease severity. Isolates of *P. volutum* consistently decreased root mass and root depth compared to *P. torulosum* and the uninoculated control after four weeks of exposure to heat stress (Figure 4). *Pythium volutum* was readily re-isolated from diseased root tissue and re-inoculated to creeping bentgrass to confirm pathogenicity.

Epidemiology of *Pythium* root dysfunction

From our pathogenicity experiments, we determined that *P. volutum* was the causal agent of PRD and that infection occurs when soil temperatures are cool. However, PRD symptoms do not develop until creeping bentgrass is subjected to heat stress. We decided to expand on this to determine the soil temperature thresholds for *P. volutum*, which would enable superintendents to time preventive fungicide recommendations based on soil temperatures.

To determine the optimal temperature range for infection by *P. volutum*, A-1 creeping bentgrass was seeded into cone-tainers containing sand meeting USGA specifications and placed in the greenhouse. Eight weeks after seeding, plants were inoculated with one of five *P. volutum* isolates. After inoculation, the cone-tainers were transferred to growth chambers at 54 F, 61 F, 68 F or 75 F. After four weeks, the temperature in all chambers was increased to 90 F/79 F day/night to induce foliar symptoms. Typical PRD foliar symptoms developed in all infection temperature treatments after two weeks of heat treatment. The severity of PRD was greatest when *P. volutum* infected creeping bentgrass roots at 61 F (Figure 5). Reductions in root depth were not observed prior to raising the temperature to 90 F/79 F. However once the tempera-

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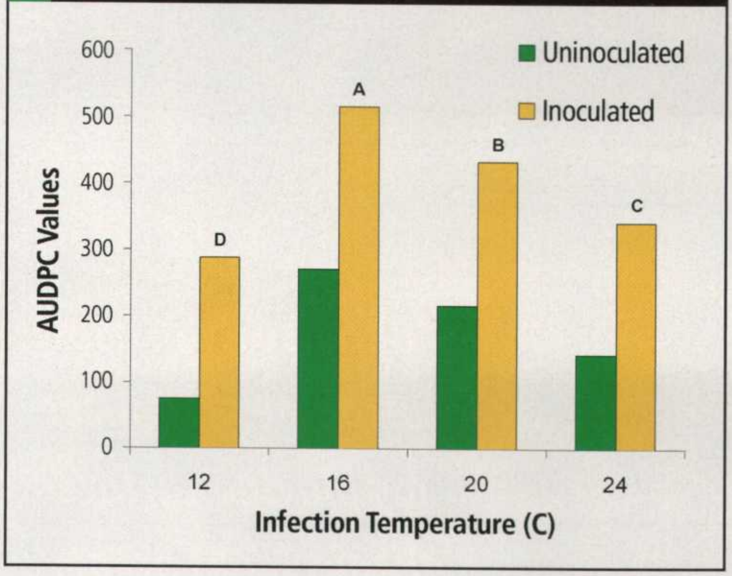
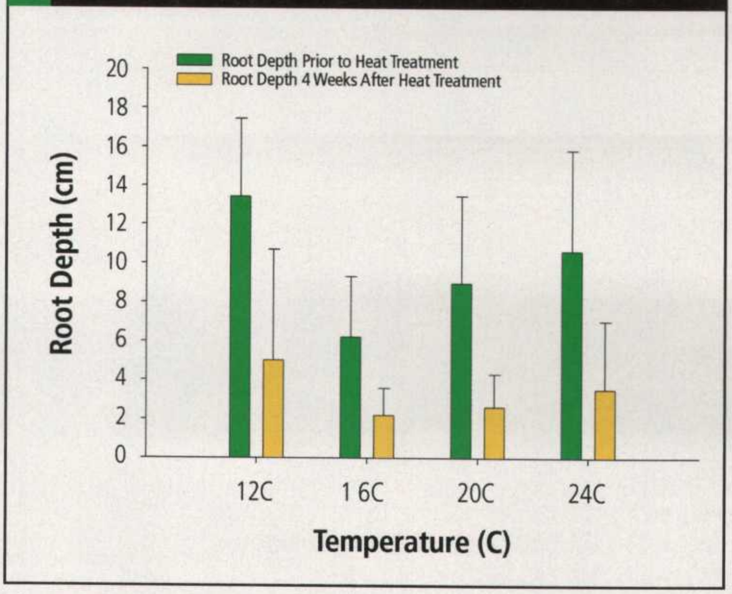
FIGURE 5



This graph shows the effects of infection temperature on Pythium root dysfunction severity. The severity of foliar symptoms was visually estimated 14 days after heat treatment. Area Under the Disease Progress Curve Values were calculated from disease severity ratings. Bars followed by the same letter are not significantly different, according to Waller-Duncan k-ratio t-test (k=100).

FIGURE 6



This graph shows the impact of Pythium volutum infections on creeping bentgrass root depth as affected by infection temperature. Green bars represent creeping bentgrass root depth prior to increasing the temperature in the growth chamber to 32 degrees Celsius/26 degrees Celsius (day/night). Yellow bars represent creeping bentgrass root depth four weeks after initiation of heat treatment.

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ture was elevated, root dieback rapidly occurred (Figure 6).

Conclusions

Although *P. arrehenomanes* and *P. aristosporum* have been reported as causes of PRD, we have found that *P. volutum* is the most important causal agent of PRD in the southeastern United States. *Pythium volutum* infects creeping bentgrass roots in the fall and spring when soil temperatures are between 54 F and 75 F, yet foliar symptoms are not expressed until creeping bentgrass is subjected to periods of heat and/or drought stress. Therefore, to obtain effective preventive control of PRD, fungicides should be applied in the fall and spring when soil temperatures are in this favorable range. Finally, creeping bentgrass root depth and root mass is not adversely affected during infection. However, root dieback occurs rapidly during exposure to heat.

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See more articles on this topic by searching for "Pythium" at www. turfgrasstrends.com.

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