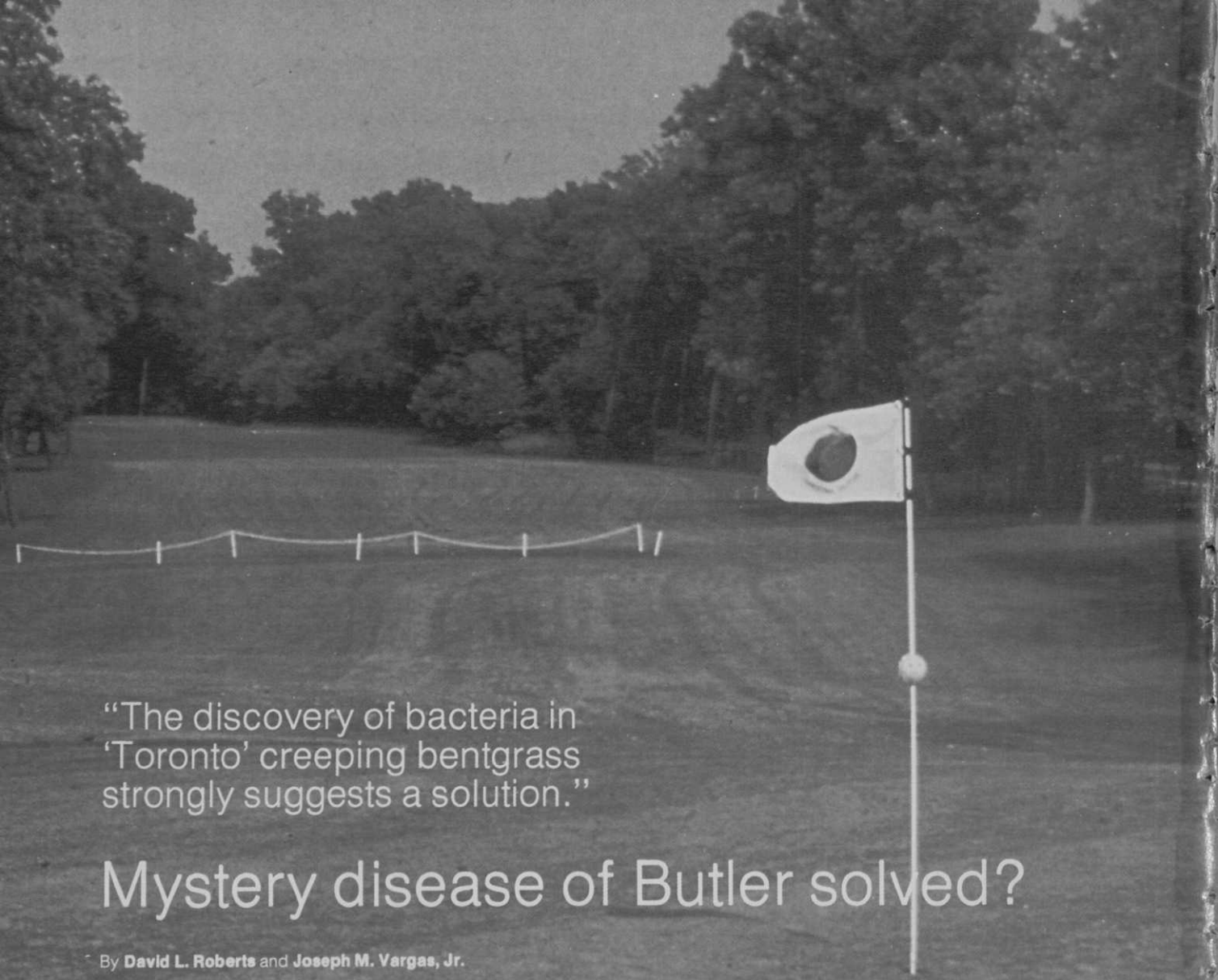

"The discovery of bacteria in 'Toronto' creeping bentgrass strongly suggests a solution."

Mystery disease of Butler solved?

By **David L. Roberts** and **Joseph M. Vargas, Jr.**

The mystery disease of 'Toronto' creeping bentgrass (*Agrostis palustris* C-15) plagued the 1980 PGA tournament at the Butler National Golf Course in Oak Brook, Illinois. The elite creeping bentgrass withered away with no relief from common cultural or fungicide control practices. Symptoms and spread of the disease suggested an infectious, disease-causing organism was involved; however, investigators had difficulty diagnosing the problem. Tentatively, it was called red leaf spot, crown and root rot, low temperature Pythium or some soil disorder.

Annual bluegrass (*Poa annua*) and other cultivars of bentgrass did not appear to be affected by the disease (Fig. 1). When affected plants were observed closely in the early stages of disease in May and early June, the leaf tips were wilting from the tip back and appeared dark green, twisted and shriveled (Fig. 2). Initially, roots appeared white and in good health even after leaves had wilted. In some instances, internal discoloration of roots and crowns was observed. Eventually the leaves turned brown, and crown and root regions begin to decompose. Similar symptoms were reported in at least 10 other golf clubs in the Chicago area in 1980 and in previous years. The disease seemed to be favored by rainy periods followed by cool nights and warm days.

Most reported turfgrass diseases are caused by fungi, however, pathogenic fungi could not be consistently isolated from diseased plants after numerous attempts.

With no easy answer in sight, samples were prepared for transmission electron microscopy (TEM). TEM enables small objects to be magnified as much as 300,000 times compared to the commonly used light microscope which magnifies objects 1,000 times their normal size. In a transmission electron microscope, a beam of electrons strikes an ultra-thin section of plant material and forms an image of fluorescent screen; this enables one to look very closely into the cells of plants.

When ultra-thin sections of diseased 'Toronto' bentgrass plants from Butler were observed with TEM, numerous rod-shaped bacteria were observed within the xylem vessels (Figs. 3 and 4). (Photomicrographs were prepared by Dr. Karen K. Baker and D. L. Roberts, Center for Electron Optics, Michigan State University, in June and July of 1980.) Bacteria are very small, unicellular microorganisms which may be beneficial or destructive. Certain kinds of bacteria cause diseases of other cultivated crops and diseases of humans such as cholera, typhoid fever and strep throat. The bentgrass bacteria measured approximately 0.5 x 1.5 μm (1 inch 25,400 μm) and their outer walls appeared rippled (Fig. 5). The progressive wilt symptoms are easily explained because the bacteria had apparently infected the xylem of the plant's vascular system (where water and nutrients move from the root to the

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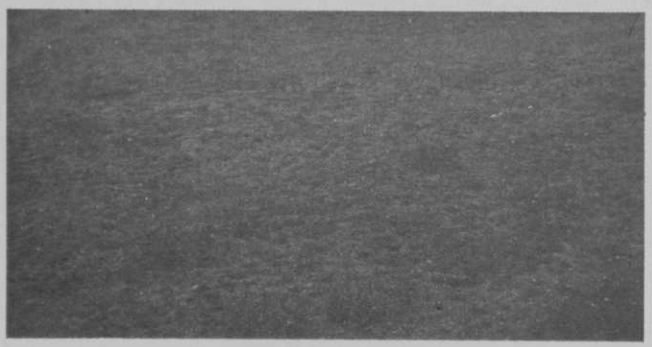

Figure 1. 'Toronto' green at Butler afflicted with Mystery disease. Note the dieback and thinning of C-15 while *Poa annua* and other cultivars of bentgrass appear unaffected.

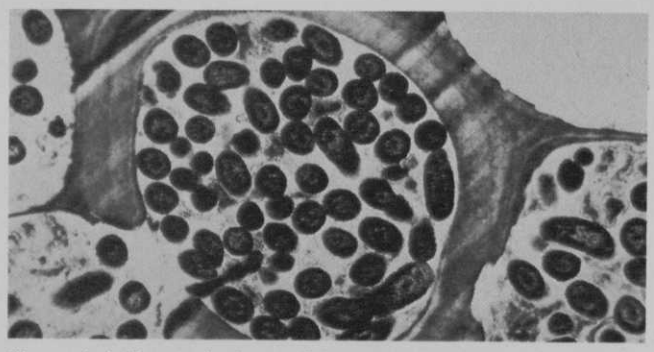

Figure 4. A 'Toronto' xylem cell in cross-section. Rod-shaped bacteria multiply to great numbers and probably inhibit upward movement of water and nutrients to leaves. Magnification approx. 8500X. (June, 1980)

'Toronto' creeping bentgrass

(Agrostis palustris C-15*)*

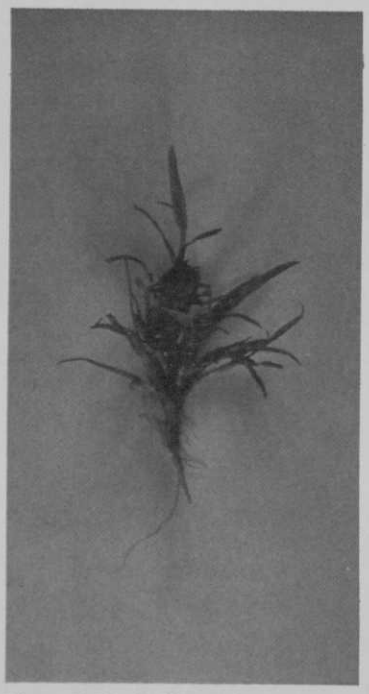

Figure 2. Single 'Toronto' creeping bentgrass plant with "green wilted" leaf tips. The wilt appears to be caused by bacteria clogging the xylem vessels and preventing water movement in the plant.

Figure 5. Single bacterium in the xylem of creeping bentgrass. Bacteria possess a rippled cell wall and hence have been tentatively called rickettsia-like bacteria. Magnification approx. 60,000X. (July, 1980)

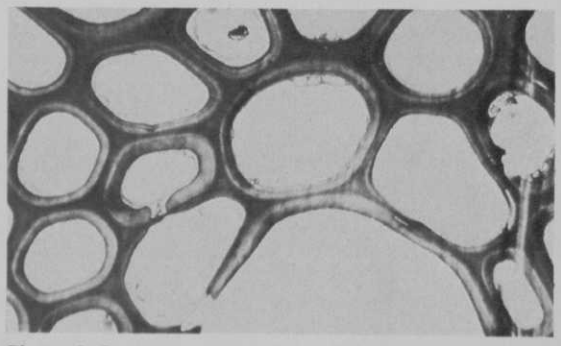

Figure 6. Cross-section of healthy 'Toronto' creeping bentgrass plant. No bacteria were found in the vascular system of symptomless 'Toronto' creeping bentgrass plants. Magnification approx. 3500X. (July; 1980)

Figure 3. Leaf cross-section of 'Toronto' vascular tissue. Bacteria appear to be limited to xylem cells of the vascular system. Magnification approx. 6000X. (July, 1980)

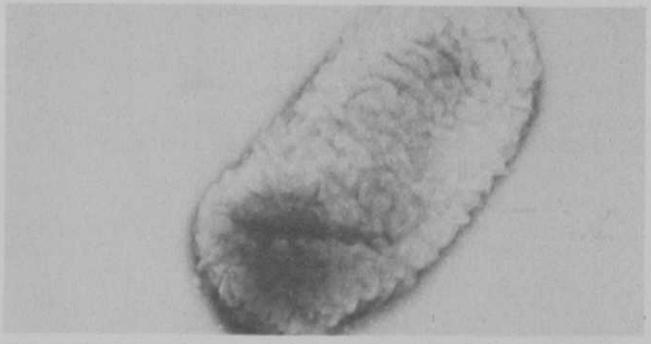

Figure 7. Non-sectioned, whole bacterium with rippled cell wall. This bacterium has been isolated with high frequency from diseased 'Toronto' creeping bentgrass. Magnification approx. 60,000X. (September, 1980)

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Mystery *from page 16*

foliage) and multiplied to such an extent that upward movement of water and nutrients was impeded by their presence. Wilt symptoms and the presence of bacteria in xylem cells prompted us to name the disease "bacterial wilt" of 'Toronto' creeping bentgrass. Bacteria were not found in any apparently healthy plants (Fig. 6).

The bacteria associated with diseased 'Toronto' resembles certain rickettsia-like bacteria in size, morphology and location within the infected plant. Pierce's disease of grapevines, phony peach disease, alfalfa dwarf and almond leaf scorch are some diseases caused by rickettsia-like bacteria.

Because the commonly used fungicides were ineffective on Butler National's 'Toronto' greens, it is our feeling that the bentgrass diseases, red leaf spot, crown root rot, and low temperature *Pythium* were of minor importance in June of 1980. The discovery of bacteria in wilting 'Toronto' creeping bentgrass strongly suggests a solution to the mystery disease that devasted 'Toronto' greens of Butler National. In addition, this bacterial disease may represent a significant breakthrough in the unsolved "C-15 problem" which has plagued numerous 'Toronto' greens in the Midwest for many years. Red leaf spot, crown and root rot and this newly discovered bacterial problem may have even been confused one for the other throughout the years.

Several different bacteria have been isolated from diseased plants in high frequency (Fig. 7). Some success has been achieved in demonstrating their pathogenicities, however, not with consistent results. Efforts ares continuing in our laboratory to work with the bacterium which was observed in diseased 'Toronto' plants.

Bacteriocide control experiments will be continued from last Fall in the Chicago area. Copper fungicides and antibiotics which give bacterial disease control on other cultivated crops will be tested on 'Toronto'.

Since this is the first reported bacterial disease of turfgrass, its importance cannot be overemphasized. Research on 'Toronto' bacterial wilt will enable turfgrass specialists to combat new or already existing bacterial diseases which are undoubtedly out there, but attributed to other pathogens or physiological disorders . . . as the C-15 mystery has been for quite a few years. **GB**