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CDGA Update and the Lance Nematode

The CDGA Research Program Update

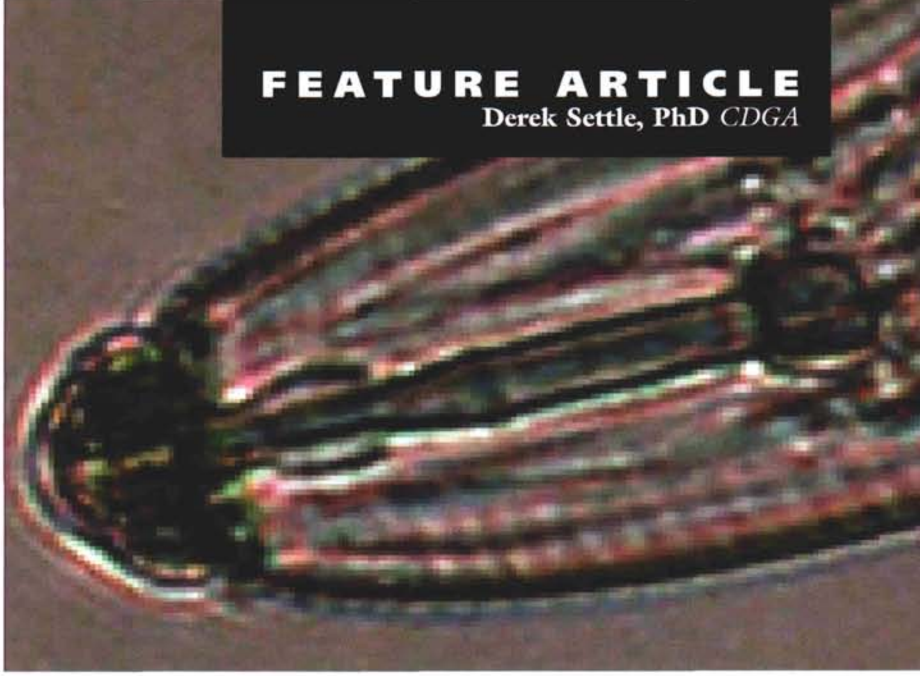

FIGURE 1

During spring 2006, I was hired to allow Dr. Randy Kane to transition into the role of Turf Program Advisor. From central Illinois Dr. Kane continued to provide turf diagnostics and assist CDGA staff collect golf course rating data. He will continue to serve in this capacity in 2007. During 2006, the turf staff conducted approximately seven separate field studies, the majority located in Lemont at the CDGA's Sunshine Golf Course. Other research was conducted at two North Chicago locations; fairy ring was studied at Twin Orchard Country Club in Long Grove and dollar spot was studied at North Shore Country Club in Glenview.

As plans are made for the upcoming year for turf research, the primary interest remains the same: The investigation of pathogenic organisms, and evaluation of techniques to prevent or alleviate disease symptoms to benefit golf course superintendents. Additionally, we also work on other issues such as ways to suppress moss on greens with support by the USGA.

The Lance Nematode
Research Increases the Density Needed for Bentgrass Injury

In this report I will share a portion of my turf background that I bring to the CDGA – investigations of nematodes associated with bentgrass greens. This research was conducted during my PhD studies at Kansas State University from 2000 to 2004. I begin by acknowledging the support of three influential scientists and mentors; Drs. Jack Fry and Ned Tisserat, and in particular K-State nematologist Tim Todd. The research focused on the lance nematode, its seasonal population fluctuations, its reproduction among different turfgrass hosts, and its numbers necessary for creeping bentgrass damage.

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Nematodes are a diverse group of non-segmented round worms that exist both aquatically and terrestrially with varied sources of food. Of terrestrial nematodes, parasitic root-feeding nematodes are microscopic and are identified by a specialized mouth part; the stylet **(Figure 1).** It allows nematodes to exploit plant roots as a food source. The stylet probes roots and functions in a way similar to a hypodermic needle attached to a syringe. It allows nematodes to both inject and withdraw partially digested cellular contents from roots. Phytoparasitic nematodes are classified by their feeding habit. Nematodes can be either migratory or sedentary as they feed on roots. Nematode orientation to the root surface can be either endo- or ecto-parasitic; they feed either inside or outside of roots and sometimes in between (semi-endoparasitic). In putting greens, the vast majority of root-feeding nematodes commonly encountered are migratory ectoparasites. Sedentary endoparasites of greens are also found, but with much less frequency.

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History – Nematodes and Bentgrass

The first mention of nematodes associated with golf putting greens appeared in 1954, when Troll and Tarjan reported large populations of plant parasitic nematodes were found in diagnostic samples in Rhode Island. In 1963 Illinois researchers conducted the first extensive nematode survey of greens of Chicago and central Illinois. During summer, they found nematode genera of stunt *(Tylenchorhynchus)*, spiral *(Helicotylenchus)*, lance *(Hoplolaimus)*, and ring *(Criconemella)* were frequent residents of sand rootzones **(Figure 2)**. Of those, the stunt nematode was found with greatest frequency and was most numerous compared to other nematodes. Later, in the 1990s extensive investigations of the stunt nematode were conducted in Illinois by Davis, Kane, Wilkinson, and Noel (1994).

FIGURE 2

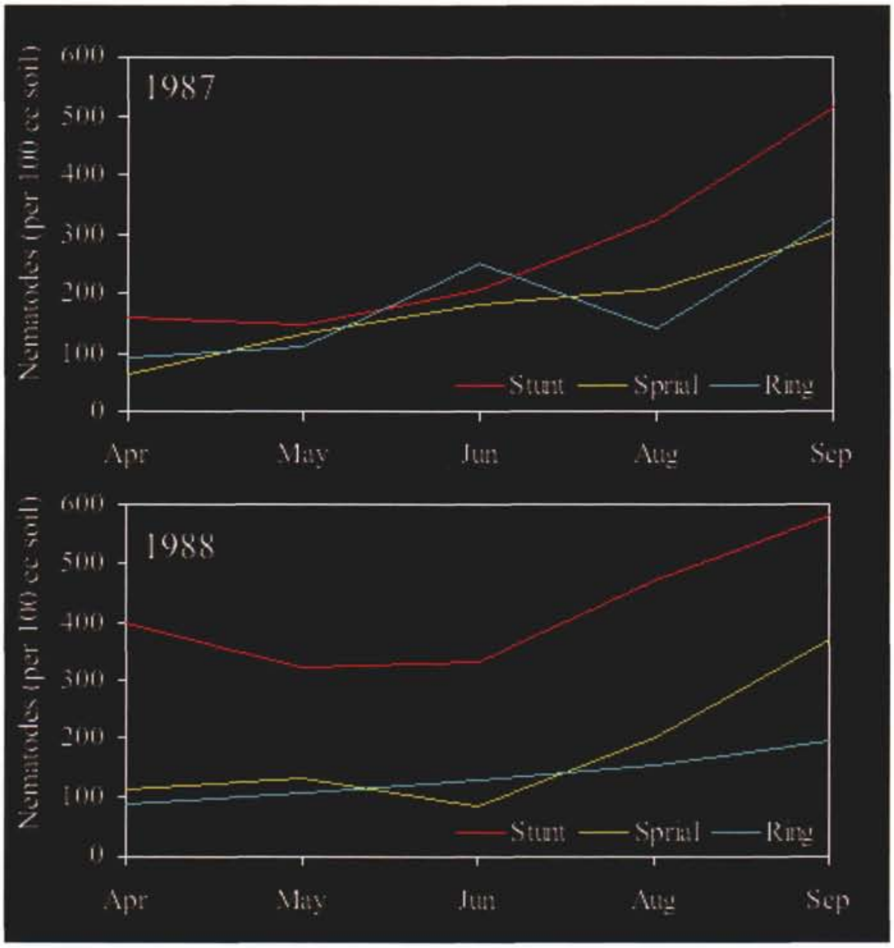

FIGURE 3

In the US, the first visible effect of nematodes on bentgrass health was reported in 1970 by southern California researchers. High root knot nematode *(Meloidogyne)* populations were associated with excessive midday wilting of Seaside bentgrass *(Agrostis palustris)* and annual bluegrass *(Poa annua)*. Shortly thereafter, Illinois researchers demonstrated the same root knot nematodes combined with pin *(Pratylenchus)* nematodes reduced Toronto bentgrass shoot growth in the first controlled greenhouse study to demonstrate pathogenicity. In 1972, Laughlin and Vargas showed growth reduction of Toronto bentgrass by stunt nematodes varied according to soil temperature, demonstrating the idea that nematode effects of greens may be seasonal.

Surveys – Nematodes on Putting Greens

Most of what we know about nematodes and turfgrass is only population surveys of sites. From the mid-1970s to the present, many nematode surveys of putting greens were published and represented golf courses in Hawaii, Kansas, New England, New York, North Carolina, Ohio, Oklahoma, and Washington. All showed several phytoparasitic nematodes are common inhabitants of sand-based putting greens. In the 1980s an unpublished survey by Dr. Kane found three nematode species were most common on sand-based greens in Chicago – stunt, ring and spiral **(Figure 3)**. Likewise, a Kansas survey in the 1990s found those nematode species common on greens across the state. In total 11 species were identified, but only high populations of the lance nematode were associated with reduced bentgrass quality at midsummer. In 2000, K-State researchers returned to the question of lance nematodes on bentgrass greens in Kansas. My objective was to determine the pathogenicity of the lance nematode to this host.

In Search of a Population Damage Threshold for Bentgrass

A nematode damage threshold is the number of nematodes per 100 cc soil above which plant health is reduced due to root reduction or dysfunction. Our understanding of populations of root-feeding nematodes that cause damage is lacking, because demonstration of above-ground effects experimentally in the field has proven very difficult. In the greenhouse, multiple turfgrass studies have shown nematodes reduce root weight and length. However, visible canopy effects are difficult to demonstrate; turfgrass is resilient in tolerating a degree of root loss by nematodes. Nematode damage thresholds of turfgrass are confusing because nematology/diagnostic labs typically use different numbers for an individual nematode species. References have compiled nematode damage thresholds to many turf-

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grasses such as creeping bentgrass, and Houston Couch's Diseases of Turfgrasses (1995) is one example. A short coming of estimates for turf-grass injury by nematodes is that they may be derived from greenhouse experiments where conditions are very different from the field.

At Kansas State, my biggest task was to experimentally demonstrate aboveground nematode damage in the field. On an area of A-4 creeping bentgrass, microplots were established to allow introduction of controlled levels of lance nematodes. A microplot was a 12-inch diameter PVC pipe cut so that its length encompassed the entire rootzone from the clay base of the green to its upper surface. Each microplot edge was flush with bent-grass sod and allowed normal green maintenance; clipped at 5/32 inch height six days weekly with a triplex mower **(Figure 4)**. Each microplot began as a pasteurized rootzone which was inoculated with of varying amounts of water containing extracted lance nematodes. A total of 20 microplots functioned as nematode

FIGURE 4

cages and the experimental design was a completely randomized block design with five replications. Four increasing levels of lance nematodes existed; 0, 1/2X, 1X, and 2X. Monthly, lance nematodes were extracted from each microplot by light sucrose extraction. During summer, plant health measurements were also taken. Over a period of two years nematode levels in microplots had grown to densities comparable to naturally infested greens **(Figure 5)**.

As previously observed in Kansas, I found visual quality of bentgrass was influenced by lance nematodes at summer. But the level required to reduced visual quality below an acceptable level (0 to 9 scale; with 9 = best, and 6 = minimum acceptable quality) varied monthly, and so a single damage threshold did not exist. Instead, a range of 200 to 1,000 lance nematodes per 100 cc was found capable of causing unacceptable quality of bentgrass during June to September in two years. This range is higher than all previously proposed damage thresholds of lance nematodes on bentgrass.

Currently, published damage threshold levels of the lance nematode of bentgrass are anywhere from 50 to 150 per 100 cc soil. These numbers are too low and only overestimate the pathogenicity of the lance nematode on creeping bentgrass. A better damage threshold would be to use the number of lance nematodes capable of reducing bentgrass quality appreciably. In Kansas, where stressful midsummer conditions are the norm, an average of 400 lance nematodes reduced bentgrass visual quality by10%; a one point reduction on a 0-9 quality scale. This damage threshold is not static and is influenced by bentgrass green health during summer. If overall bentgrass health and quality is high at midsummer, a reduction of bentgrass quality to unacceptable levels by dense lance nematode populations may be avoided. This means golf course superintendents can mask or avoid lance nematode damage by optimizing bentgrass health during summer with certain cultural practices such as midday hand-watering. For example, in a separate study of a naturally infested experimental green, I found a 5/32 inch mowing height maintained acceptable visual quality regardless of lance nematode number unlike the 1/8 inch height **(Figure 6)**. Optimizing irrigation of greens to avoid wilt is another strategy that likely compensates for nematode root damage.

It is important to point out that even when dense lance nematode populations cause unacceptable quality, populations are never uniform across a green. Dense lance nematode populations occur in isolated pockets or aggregates. Therefore, at midsummer only a small percentage of an entire green has the potential to suffer visually. The lance nematode findings in Kansas suggest other ectoparasitic nematodes commonly associated with greens in the Midwest are probably not as damaging as previously thought. Historically, stunt,

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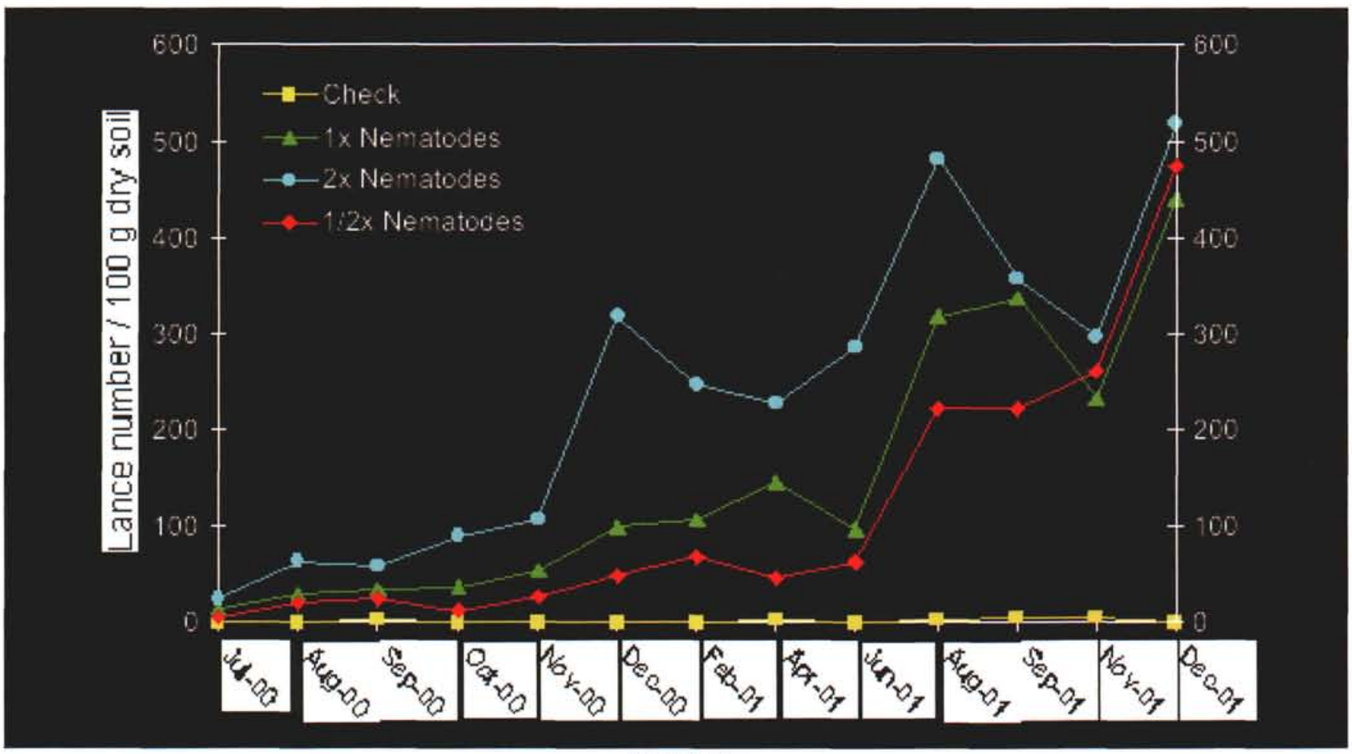

FIGURE 5

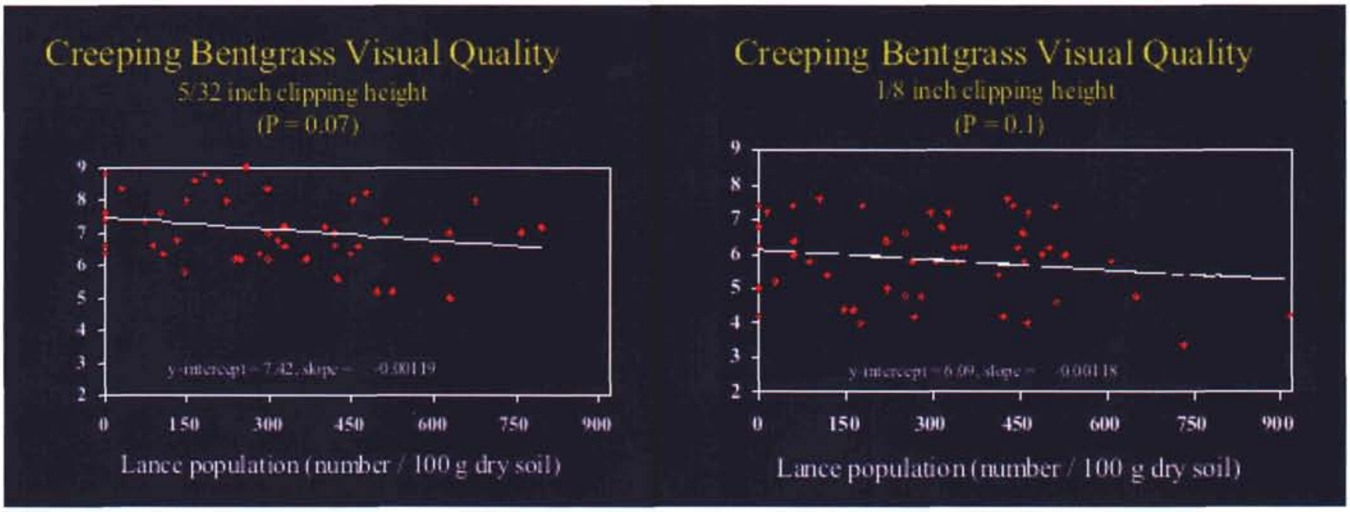

FIGURE 6

ring and spiral nematodes are considered to be less damaging to roots. The lance nematode is not only greater in size and has a large sylet **(Figure 7)**, but was also recently found to preferentially feed as migratory endoparasites of bentgrass roots when juvenile (Settle et al., 2006).

Summary – Nematodes of Bentgrass Greens

In addition to the lance nematode, two other nematodes, the root knot and the cyst, are regarded to be capable of reducing bentgrass health at summer. Root knot and cyst nematodes are sedentary endoparasites of roots and this feeding habit has a greater ability to disrupt root function compared to ectoparasities. A recent survey of golf courses in New England suggests that cyst nematodes may be more common on golf greens than previously thought (Jordan and Mitkowski, 2006). In Chicago, Dr. Kane has found two instances of patchy wilting on greens associated with high levels of cyst nematodes *(Heterodera iri* within *H. avenae* group). In 2006, the CDGA investigated one Chicago site where cyst damage had occurred in the past. The cyst nematodes were still present, but their numbers at summer were low. The importance of the cyst and root knot nematodes on putting green health at summer is poorly understood and further research is warranted.

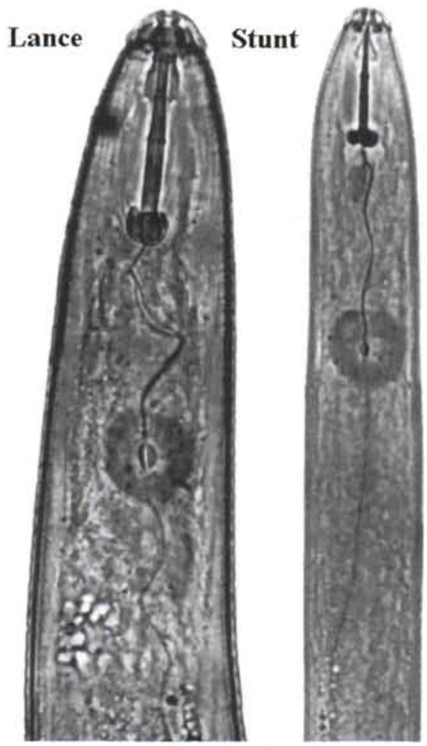

FIGURE 7

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