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Past and Present: Dollar Spot Research from Kansas State to Chicago

A disease resistant bentgrass cultivar allows flexibility to control dollar spot

Figure 1. Fungal mycelium of *Sclerotinia homoeocarpa*, causal agent of dollar spot disease.

In this article I will report some of my dollar spot research. Beginning in 1997-1999 and including a study done in 2006. In 1997 I began bentgrass research at Kansas State University in Manhattan, Kansas, as a M.S. student under Drs. Jack Fry and Ned Tisserat. In 2006 the CDGA Turf Program staff conducted a bentgrass-fairway dollar spot experiment at two locations. Interesting results were obtained.

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The Fungal Pathogen – *Sclerotinia homoeocarpa*

Introduction

Dollar spot (*Sclerotinia homoeocarpa*) is the most important fungal disease of creeping bentgrass (*Agrostis palustris*). In humid climates the fungal disease is a severe, persistent problem in bentgrass. *S. homoeocarpa* does not produce spores; instead it is soil-born. The dormant mycelium in plant material insures its survival year to year. Temperature for its development ranges widely from 40° F to 90° F. Optimal *S. homoeocarpa* growth is from 70° F to 80° F. Dollar spot is active in summer as long as periods of leaf wetness exist. It is not uncommon for dollar spot to be a chronic problem from spring to fall in humid Midwestern regions such as Illinois. In general, maximum epidemics occur during September and October when inoculum levels are greatest and prolonged leaf wetness is common. It is frequently stated that a majority of the fungicide used by golf course superintendents is used against dollar spot disease. Indeed, each year golf course fungicide programs are built with the

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knowledge that dollar spot will be present. Programs are adjusted according to fungicide resistance, which some **S. homoeocarpa** genetic strains are capable of developing.

Symptoms

Early in the morning when atmospheric dew and plant produced guttation fluid are present on leaf, fungal mycelium can appear. It looks similar to a spider web when seen for the first time (**Figure 1**). First, water-soaked leaf blades give way to a lesion that is a dead leaf section, the initial color of which is a bleached white with a reddish border (**Figure 2**). Typical 'text book' lesions are located mid-blade, and have an hour-glass shape, especially on higher mown turf such as Kentucky bluegrass. On greens with a low mowing height, dollar spot damage symptoms occur as small infection centers that measure ? to ? inches in diameter. It is unknown what restricts individual infection center size. *Poa annua* is highly susceptible to dollar spot; symptoms in spring/early summer often develop first in patches where it is a component of bentgrass greens and fairways (**Figure 3**). If untreated a hundred or more 'spots' can occur in an area as small as ten square feet. Over time, their close proximity creates coalescence and large areas of dead turfgrass can result.

Figure 2. A S. homoeocarpa lesion on a creeping bentgrass leaf blade is a diagnostic feature of dollar spot disease.

Past

For my M.S., between 1997 and 1999, I ran the usual fungicide tests to control dollar spot and brown patch in a single variety of creeping bentgrass, such as Penncross, for Ned Tisserat my major professor. For my other major professor, Jack Fry, I conducted a similar test on a number of bentgrass varieties simultaneously. It is something they call co-advised. This filled my spare time as my M.S. thesis detailed the disease brown patch caused by the soil-born fungus *Rhizoctonia solani*: "Disease development in tall fescue and perennial ryegrass as affected by cultural practices."

Figure 3. Light-green colored patches of Poa annua *infected with dollar spot. Surrounding creeping bentgrass is unaffected owing to its greater disease resistance.*

Background of the 1997 study

Today it is common knowledge that genetic selection by plant breeders has had a big impact on golf greens, but, prior to the release of an individual seeded bentgrass variety, it's impact is largely unknown. Primarily, this is because only a select number of releases ever become popular and are used extensively on golf courses. In the mid-1990s, Dr. Fry had a hunch that fungicide requirements for controlling disease with some newer varieties might be substantially different than the requirements for Penncross. The need for fungicide efficacy information was apparent because new bentgrass cultivars had begun to displace Penncross from Kansas greens. We had two main questions about the new bentgrass varieties back in 1997. Did disease susceptibility differ when the new varieties were compared to the old standard, Penncross? And, can genetic differences in newer bentgrass cultivars change the way golf course superintendents manage a chronic disease like dollar spot?

A large wave of creeping bentgrass cultivars had just entered the

market and one, L-93, had increased resistance to dollar spot disease; the primary attribute for which it was selected. All others were released with the standard 'disease resistant' label, but extensive evaluation of each cultivar's dollar spot susceptibility had just begun with their inclusion in the National Turfgrass Evaluation Program (NTEP). It was really anyone's guess how a fungicide program to prevent dollar spot on a new bentgrass cultivar in the Midwest might perform. Fungicide efficacy in controlling dollar spot in places such as Dallas, Texas, and Wichita, Kansas, where semiarid describes the environment, was likely very different from a cool, humid, Midwestern region such as Chicago, Illinois. Thus, we conducted a study in Manhattan, Kansas – a semi-cool, humid environment where high dollar spot pressure exists in fall and must be managed by golf course superintendents.

The Evidence 10 years ago

The Kansas State study was conducted between 1997 and 1999 on a USGA green at the Rocky Ford Turfgrass Research Center in Manhattan, Kansas. The green was mowed daily at 5/32 inches, received 4 lbs. N/1,000 sq. ft./yr and was irrigated with approximately 0.2 inches of water each rain-free day during the summer. Cultivars were replicated three times, and consisted of Crenshaw, L-93, Penncross, and Providence. Fungicide treatments were imposed over each cultivar at manufacturer's recommended rates on plots that measured approximately 3 by 7 feet. Fungicides were applied using a backpack, CO_2-powered, boom sprayer with flat-fan nozzles in water equivalent to 2.0 gallons per 1000 square feet. Dollar spot was quantified by counting the number of infection centers per plot. Visual quality was also assessed, and no phytotoxicity was observed. Data were subjected to analysis of variance using Fisher's LSD test and then each treatment was summarized for the season using "area under the disease progress curve" (AUDPC).

We found dollar spot susceptibility among Crenshaw, L-93, Penncross, and Providence bentgrass cultivars differed. From the start, compared to all other bentgrass cultivars, Crenshaw had greater susceptibility to dollar spot than any of the others (**Figure 4**). Disease pressure increased in the next two years and Crenshaw became a good indicator of when environmental conditions were conducive to *S. homoeocarpa* infection. By the second year it was obvious that L-93 displayed the best dollar spot resistance (**Figure 5**). The third and final year was one of extended cool, humid conditions in Northeast Kansas. Crenshaw without a fungicide resulted in dollar spot pressure that was five times greater than in 1997 (**Figure 6A**). That year provided the best illustration of how fungicide programs can be influenced by cultivar selection.

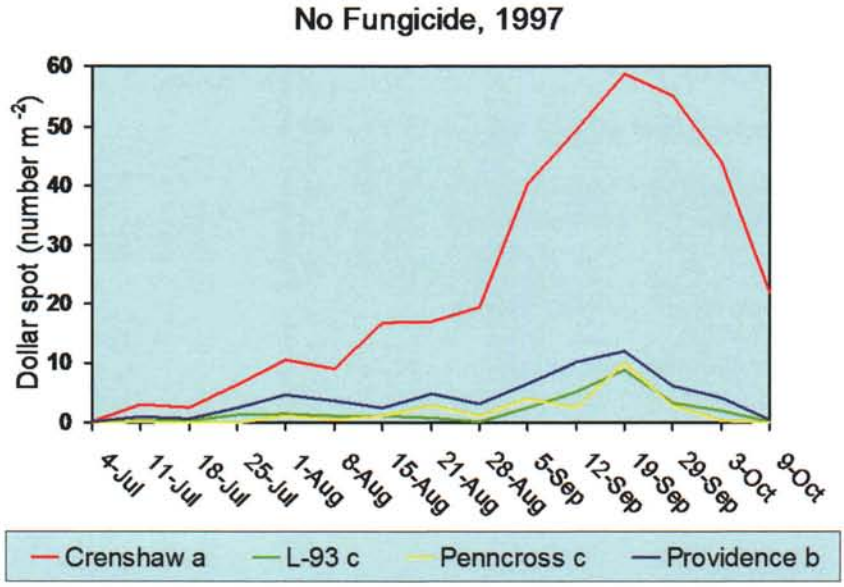

Figure 4. Bentgrass cultivars differed in susceptibility to dollar spot disease in Manhattan, Kansas, 1997. All dates summarized together by area under the disease progress curve (AUDPC). A different legend letter indicates a statistical difference at P < 0.05.

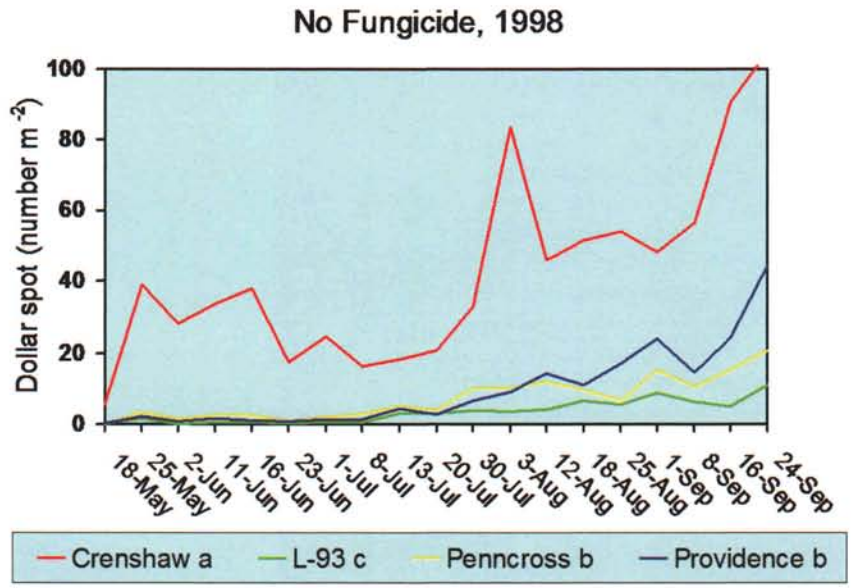

Figure 5. Bentgrass cultivars differed in susceptibility to dollar spot disease in Manhattan, Kansas, 1998. All dates summarized together by area under the disease progress curve (AUDPC). A different legend letter indicates a statistical difference at P < 0.05.

Preventive Fungicide Strategies - 1999

We examined several preventive strategies to control dollar spot across the four cultivars. Applications were

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timed on a calendar basis every 7, 14, or 28 days using a CO.

Calendar-based every 14 days

We found that Chipco 26 GT 2SC (iprodione) at 4 ounces/1,000 ft² every 14 days, a local penetrant, was highly effective in suppressing dollar spot for all cultivars (**Figure 6B**). However, our preventive 14 day schedule did not allow the reduced fungicide input that we felt we could achieve with some cultivars. It turned out the preventive 14 day strategy was the only program that worked well for Crenshaw, given a year of high disease pressure.

Calendar-based every 7 days (reduced-rate)

In the late '90s, a reduced rate of chlorothalonil applied on a preventive basis was shown to effectively control dollar spot in bentgrass (Thompson, 1998). We applied Daconil Ultrex 82.5 WDG at 0.95/1,000 ft² every 7 days in 1999. Even though we had a short application interval of one week, we reduced chlorothalonil use by half when compared to a high label rate of application every 14 days. This reduced-rate strategy seemed to work well when disease pressure was low to moderate, owing either to dry environmental conditions or to genetic resistance. For the 1999 season this strategy suppressed dollar spot better on the three cultivars other than Crenshaw. Overall, it worked best for L-93 where few infection centers occurred during the season (**Figure 6C**). The presence of acceptable quality each week was an even better indicator of fungicide efficacy. The cultivars ranked neatly in order of their dollar spot susceptibility. Using the reduced-rate fungicide strategy, L-93, Providence, Penncross, and Crenshaw had acceptable visual quality of 100%, 47%, 35%, and 20%, respectively, on the dates rated (a total of 16 weekly ratings were taken from June 4th to October 1st).

Calendar-based every 28 days

A fungicide with systemic properties, such as those in the DMI family, can allow a longer duration of activity and will result in fewer applications. We found Bayleton 50W (triademefon) at 0.5 ounces/1,000 ft² + Heritage (azoxystrobin) at 0.2 ounces/1,000 ft² every 28 days worked well to suppress dollar spot on all cultivars except Crenshaw. Heritage was added to prevent brown patch in summer (**Figure 6D**). For Crenshaw this procedure worked well for 21 days, after which dollar spot break-thru occurred. A superintendent could adjust for this, but it would require one more application for the season than the other, more resistant, cultivars.

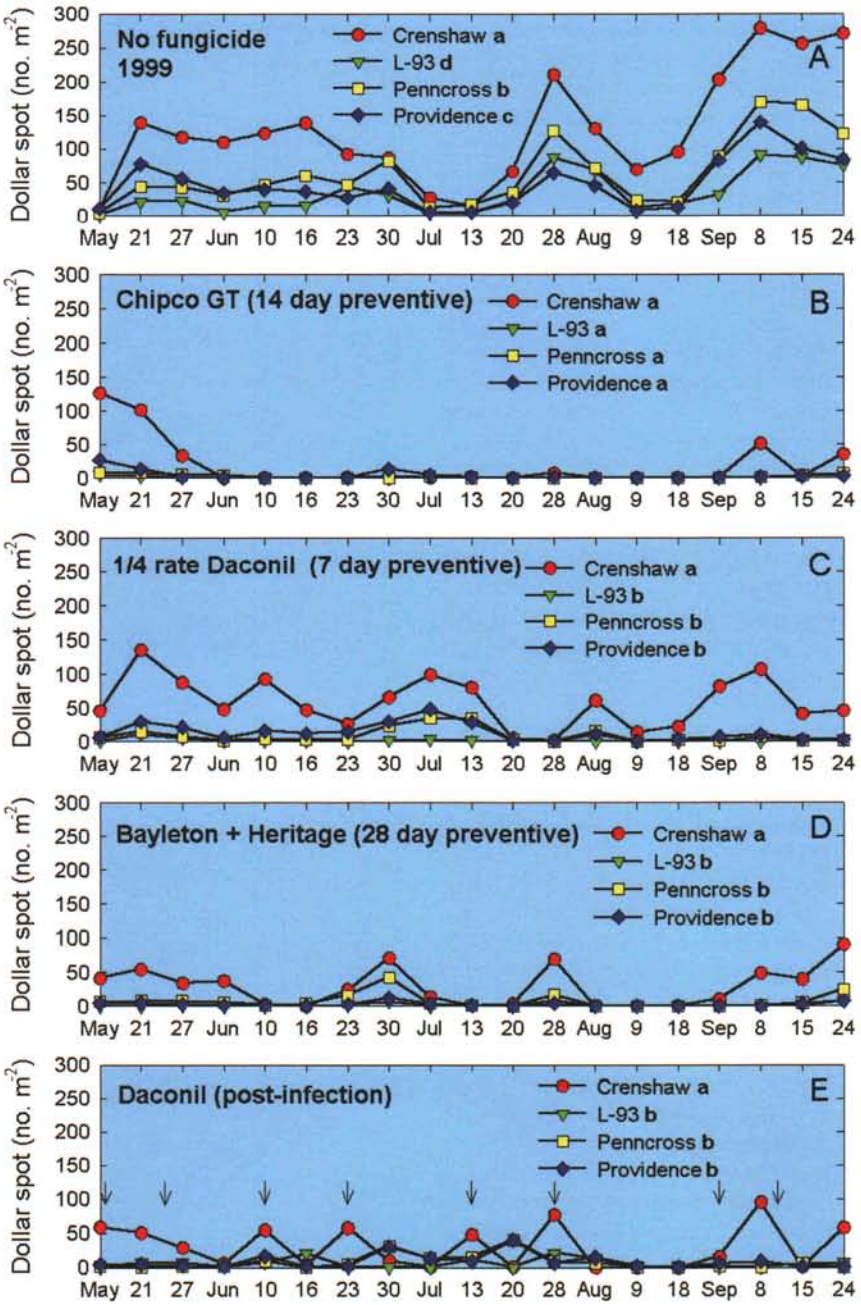

Figure 6. Treatments to control dollar spot of bentgrass cultivars are labeled A to E, and except for B, susceptibility differed without, as well as with, fungicides in Manhattan, Kansas, 1999. All dates summarized together by area under the disease progress curve (AUDPC). A different legend letter indicates a statistical difference at P < 0.05.

Curative or Post-infection Fungicide Strategies - 1999

Symptom-based

A curative or post-infection strategy requires a fungicide applica-

Figure 7. Dollar spot disease affecting treatments within an L-93 bentgrass fairway given a single application of Emerald fungicide on May 1st, May 15th, or June 1st. By October, dollar spot control is still visible given a June 1st application (foreground = 30% blight). The May applications were less effective (background = 50 and 70% blight).

tion only when a turf manager sees disease – in this case *S. homoeocarpa* infection centers. A curative fungicide strategy is the most obvious example of how you can reduce fungicide input – use only as needed. However, there is one caveat: frequent scouting for disease signs and symptoms is required.

At Kansas State, if the number of infection centers increased between weekly ratings, then Daconil Ultrex (chlorothalonil) was applied at 3.8 ounces/1,000 ft². A second application was withheld until 14 days passed (label recommendation). For the year 1999 Crenshaw required eight curative applications, indicated by arrows in Figure 6E. Penncross and Providence each required seven curative applications, and L-93 required only five. For L-93, the curative strategy cut fungicide applications in half when compared to a preventive 14 day schedule, which during my studies in Kansas required 10 applications per year. Although the curative strategy allowed a reduction in annual applications, for Crenshaw dollar spot break-thru occurred multiple times during the season, indicating that the 14 day interval was too long for that cultivar.

Present

As part of our research program for the benefit of golf course superintendents in Illinois, several disease control trials are run annually by the CDGA. Two identical fairway studies were conducted in one instance. One study was on a three-year-old established L-93 fairway at Sunshine Golf Course in Lemont. The second study was on an approximately 60/40 bentgrass/*Poa annua* fairway at North Shore Country Club in Glenview; this was considered representative of a mature Chicago golf course. In general, turf at both sites was maintained at 7/16 inches mowing height and received fertilization that totaled 2 lbs. N/1,000 sq. ft./yr. Both sites were irrigated to prevent wilt; water did not exceed 1.5 inches/wk. Fungicides were applied using a backpack, CO_2-powered boom sprayer with TeeJet flat-fan nozzles in water equivalent to 2.0 gal. per 1000 sq. ft. Plots were 4 ft. x 6 ft. and arranged in a randomized, complete block design with three replications. Statistical analysis was identical to that used in the Kansas State study.

A single systemic fungicide application - 2006

In 2006 dollar spot disease pressure in Chicago was high, because periods of rainfall occurred throughout the growing season and humid conditions prevailed. Extended leaf wetness was commonplace. A May or June single application of Emerald at a

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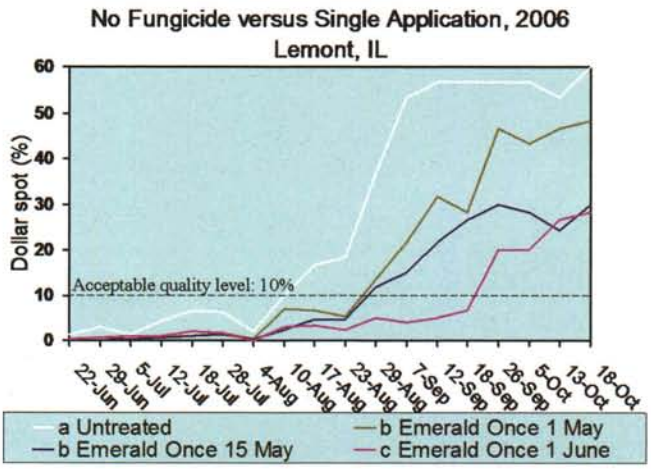

Figure 8. A single application of Emerald fungicide at label low-rate to control dollar spot of an L-93 bentgrass fairway at Sunshine Golf Course in Lemont, Illinois. All dates summarized together by area under the disease progress curve (AUDPC). A different legend letter indicates a statistical difference at P < 0.05.

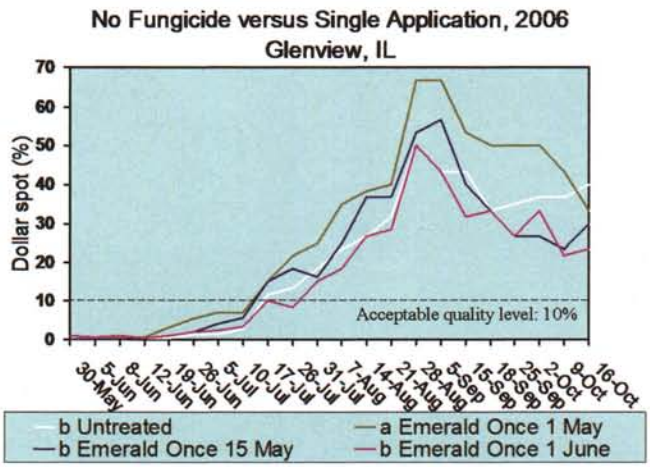

Figure 9. A single application of Emerald fungicide at label low-rate to control dollar spot of a bentgrass/Poa annua fairway at North Shore Country Club in Glenview, Illinois. All dates summarized together by area under the disease progress curve (AUDPC). A different legend letter indicates a statistical difference at P < 0.05.

low label rate of 0.13 ounces/1,000 ft² suppressed dollar spot compared to untreated plots based on AUDPC. Timing influenced the effectiveness of this strategy (**Figure 7**). In Lemont, a single Emerald application on June 1st was best and provided acceptable visual quality (less than 10% disease) until September 7th (**Figure 8**). At Glenview, the same strategy did not suppress dollar spot regardless of timing (**Figure 9**). Emerald, a penetrant fungicide of the carboxamide class, can strategically suppress dollar spot for long periods, but its usefulness may be limited to recently established bentgrass fairways, those without a *Poa annua* component.

The 'Take Home Message'

In the work conducted by me at Kansas State it turned out that Dr. Jack Fry was right. Fungicide use to control dollar spot on a bentgrass green was cultivar dependent and could be both positive and negative. We identified fungicide and cultivar combinations that would allow reduced fungicide use – just as a superintendent would do. After all, Dr. Fry would often begin talks by saying, "As environmental stewards, golf course superintendents are always in search of ways to reduce fungicide use..." Today, several influential turfgrass plant pathologists continue to say that more disease research should be done across multiple cultivars – this study was probably the first to do so. We concluded that a curative program to control dollar spot can allow reduced fungicide use. Such a program will work well as long as disease pressure remains moderate – in this case moderated by genetic resistance. In 1999, mid-August was the only time dollar spot pressure did not exist, so genetic resistance paid big dividends that year. Most fungicide strategies did not work as well on Crenshaw, and a similar scenario likely exists for dollar spot susceptible *Poa annua* – a significant component of older golf greens and fairways in the northern Midwest.

In 2006 at the CDGA we found a single Emerald fungicide application could suppress dollar spot on a golf course fairway for an extended period, but not at all locations in the study. One explanation could be that L-93's genetic resistance to dollar spot allowed increased fungicide efficacy in Lemont – similar to my experience at Kansas State. In contrast, at Glenview the fairway has a component of *Poa annua*, which is highly susceptible to dollar spot. This may explain why the single application strategy did not work there. Based on NTEP information currently available, newer bentgrass cultivars have levels of dollar spot resistance that are similar to L-93 (Anonymous, 2005). Constitutive dollar spot resistance in bentgrass can improve your ability to reduce fungicide use. This may increase a fungicide's longevity on a golf course because development of fungicide-resistant *S. homoeocarpa* populations occur with repeated fungicide use of the same chemical family. In the future, research is needed which will utilize different fungicide chemistries and/or employment strategies within a single fungicide test treatment. Those results would better reflect the dynamic efforts that golf course superintendents employ each year to manage dollar spot in creeping bentgrass and would better aid their efforts.

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