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Preventive Pest Control: What it Takes to Be the Early Bird

Was Mom right? Is an ounce of preventive REALLY worth a pound of curative? With regards to pest control and fungicides in particular, this motto has been echoed over and over in the research community. However, in reality, how can a superintendent justify a costly pesticide application when the turf is rolling like a perfect porcelain green carpet and not showing any symptoms of infection?

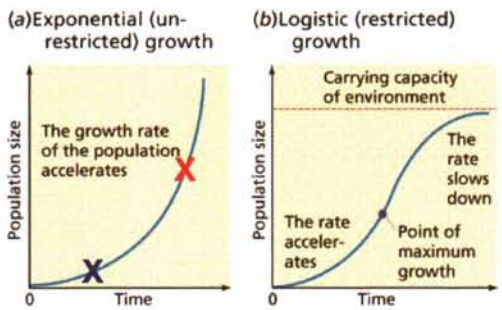

Figure 1

These two graphs represent the exponential and logistic types of increase of a pathogen population. In a turf situation, where the environment is conducive and the food (the turf) is amply available, the pathogen will increase in an exponential (i.e. rapid) fashion. Because of this, preventative controls aimed at the red X on the curve are more beneficial than curative controls where the pathogen population is increasing at a more rapid rate.

If pressed, just say that population dynamics are exponential and unfortunately don't follow a slower linear progression. If that gets a quizzical look, then say fungal cells in a conducive environment replicate a lot faster than it takes an animal to find a partner, mate, incubate eggs, and rear their children to child bearing age. If the conversation still persists, then read the following.

Justifying the Preventive Approach

In *Figure 1*, the true nature of how a pathogen population grows is graphed vs. time. One pathogen spore or cell splits into two. Those two cells can split and become four, four cells become eight, eight becomes sixteen, etc. etc. As the curve begins to ramp up, the amount of infecting cells overwhelm the plant's defenses and it becomes diseased. At this point, the population engine is really firing, and subsequent infection of nearby plants and additional turf damage is only a heartbeat away. Also, which of the two graphs on the figure is more representative of pathogen population growth on a uniform stand of juicy, very dense turf? With so many individual plants to dine on, the pathogen is only limited by its environment, so the disease takes a while to level off naturally (and if it ever does, there is no grass left and the superintendent is in real trouble!).

Let's take the two scenarios of applying a fungicide at the red X (curative) vs. the blue X (preventive) on the growth curve (Figure 1). At the red X, let's say the number of cells (individuals) is around 200,000. If the spray application and delivery is absolutely perfect, infection and growth of these 200,000 cells will stop (notice I didn't say "kill"). Unfortunately, fungicide applications don't

(continued on page 12)

make this curve behave like the big slide in Chutes and Ladders, and dramatically decrease pathogen numbers. When control wears off and if the environment is right, 200,000 cells are ready to re-infect, become 400,000 cells, and start to climb the vicious curve where they were stopped by the original fungicide application. This explains why in 2004, a bad dollar spot year, many superintendents felt like they could never "catch up" to the disease. At the blue X (early dollar spot application), let's say the number of cells is around 2,000 and growth of the pathogen is stopped at this level. When fungicide control starts to wear off, the pathogen number is still only at the 2,000 level, well below the threshold of 200,000. The benefit of the early application is realized in the time it takes this smaller number of cells to grow to a population of 200,000 when disease symptoms start to appear.

Other variables come into play when employing an "early bird" strategy which may enhance disease control. Using dollar spot as an example, the actual pathogen cells just coming out of over-wintering may be easier to control with fungicides than dollar spot cells that have had their engine (metabolism) running for a few days or weeks. As with all pathogens, it is important to know to what environments are conducive to pest outbreaks throughout the growing season. The optimum temperatures for dollar spot growth occur in the spring and fall. If early fungicide control can delay dollar spot growth into the (normally) warmer summer months, the overall amount of dollar spot will be lessened because the environment most conducive to pathogen growth has been skipped.

The Definition of Early = Measuring the Environment

Some recommendations say to make early applications using a predetermined calendar date. However, past data shows *(see Figure 2)* that dollar spot initially occurs at different times each year, sometimes differing by as many as two to three weeks. Another recommendation has been to make preventive applications at the second full mowing of the turf surface after green up. This is a better link to the environment and its relation to turf's growth habit, however it still leaves quite a bit of room for interpretation. What about slower growing bent types that don't green up very fast? What about *Poa annua*? This indicator is still not precise.

Figure 2
Reported outbreaks of dollar spot in the Chicagoland area. Notice there can be a two – three week difference between initial outbreaks depending on the type of Spring that occurs.

Early indications suggest the measuring of the heat units throughout a growing season may be the best way to figure pathogen progression. For many years, a measure called degree days was used by weed scientists and entomologists to predict weed and insect development. Degree days are calculated by:

$$\frac{(\text{High Air Temperature} + \text{Low Air Temperature})}{2} - \text{"the base"}$$

For example, a high temperature of 80 degrees and the low temperature of 60° for any given day, and accumulated degree days with a base of 50 (most commonly used) would be 20° days [((80-20)/2)-50 =20 DD_{50}]. Adding this to the total from the previous days, you get a running total of the amount of heat that has accrued during the season. (As a little secret though, the easiest way to get degree day totals is through the Plant Health Care Report published weekly by the Morton Arboretum (http://www.mortonarboretumphc.org/) – which also is a really great read for the horticulturists!)

Another method to measure the amount of heat that has gone into the system during a season is to examine soil temperatures. Soil temperatures are moderated by the soil and thatch layer and aren't subjected to great swings from day to day like air temperature. Furthermore, soil temperatures follow a fairly regular bell curve during the season *(see Figure 3)*. Many pest outbreaks are directly dependent on the timing of

when soil temperatures reach a certain level that corresponds to the pathogen's optimal growth. A warm or cool spring can shift this soil temperature curve left or right, either sparking or delaying pest problems.

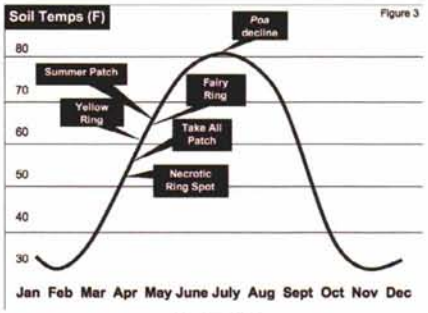

Figure 3
Average soil temperatures follow a normal bell curve when plotted throughout the season. As temperatures rise in the Spring, pest outbreaks get "sparked". Events such as Poa decline can also be attributed to times when soil temperatures spike to above 80° F.

Research

When is the best time to catch a pathogen population on its more level and initial rise on the graph? What is the best fungicide to use as an early application? Research is being conducted at the Midwest Golf House (MGH) and several other universities throughout the country to answer these questions for dollar spot control.

Currently, we are testing six fungicides, at high label rates and four early application dates using Degree Day base 50 to determine the best combination for longest control *(see Table 1)*. Sprays were applied in 2 gallons of water per 1,000 square feet with a flat fan nozzle. Plots were fertilized with one-half of a pound of nitrogen per month (important for dollar spot!). In addition, we are replicating this test on two very different types of fairway environments. The first at Midwest Golf House is on a newly established bentgrass fairway. The dollar spot has been tested as sensitive to most fungicide chemistries. On the flip side, we are also testing at North Shore Country Club (NSCC) which has old, mixed *Poa annua*/bentgrass fairways, and does have dollar spot exhibiting reduced fungicide sensitivity to the DMI fungicides (Banner, Bayleton, Eagle, Rubigan).

The Experiment

Six Fungicides	Four Application Dates			
	DMI Sensitive Site		DMI Resistant Site	
	2005	2006	2005	2006
Chipco 26 GT	April 15th (77 DD)	April 14th (77 DD)	April 11th (53 DD)	April 11th (22 DD)
Bayleton	April 28th (133 DD)	April 21st (129 DD)	April 18th (75 DD)	April 18th (72 DD)
Banner Maxx	May 5th (134 DD)	May 4th (198 DD)	May 10th (151 DD)	May 2nd (142 DD)
Banner/Daconil	May 12th (210 DD)	May 18th (252 DD)	May 16th (186 DD)	May 15th (209 DD)
Daconil				
Emerald				

Two Different Test Sites	
Pure bent, DMI sensitive	Bent/Poa, DMI resistant

Table 1

Preliminary results from 2005 suggest some conclusions.

Early applications can dramatically reduce the first wave of disease pressure, but the timing and fungicide choice is critical to providing long term control. Nearly every early application reduced the level of dollar spot severity in the plots somewhat when compared to the untreated plots. However, many of these treatments did not control dollar spot at an acceptable level when rated a month after dollar spot initially started. As expected, systemic fungicides tend to provide the longest amount of control.

Early applications can be applied too early. Applications in the first few weeks of April, or below 100 DD_{50}, did not perform as well as those applied at the beginning of May or around 150-200 DD_{50}. Best performing fungicide and application date combinations are listed in *Tables 2 & 3.*

DMI Sensitive Population – July 6th, 2005 rating

Fungicide	App. Date	Degree Day	Mean $ Spot Severity	LSD
Emerald	April 28th	133	0.5 %	A
Banner	May 12th	210	1.25 %	A
Banner + Daconil	May 5th	134	2.25 %	AB
Emerald	May 12th	210	2.5 %	AB
Emerald	May 5th	134	2.75 %	AB
Bayleton	May 12th	210	2.75 %	AB
Banner	May 5th	134	4 %	AB

Table 2

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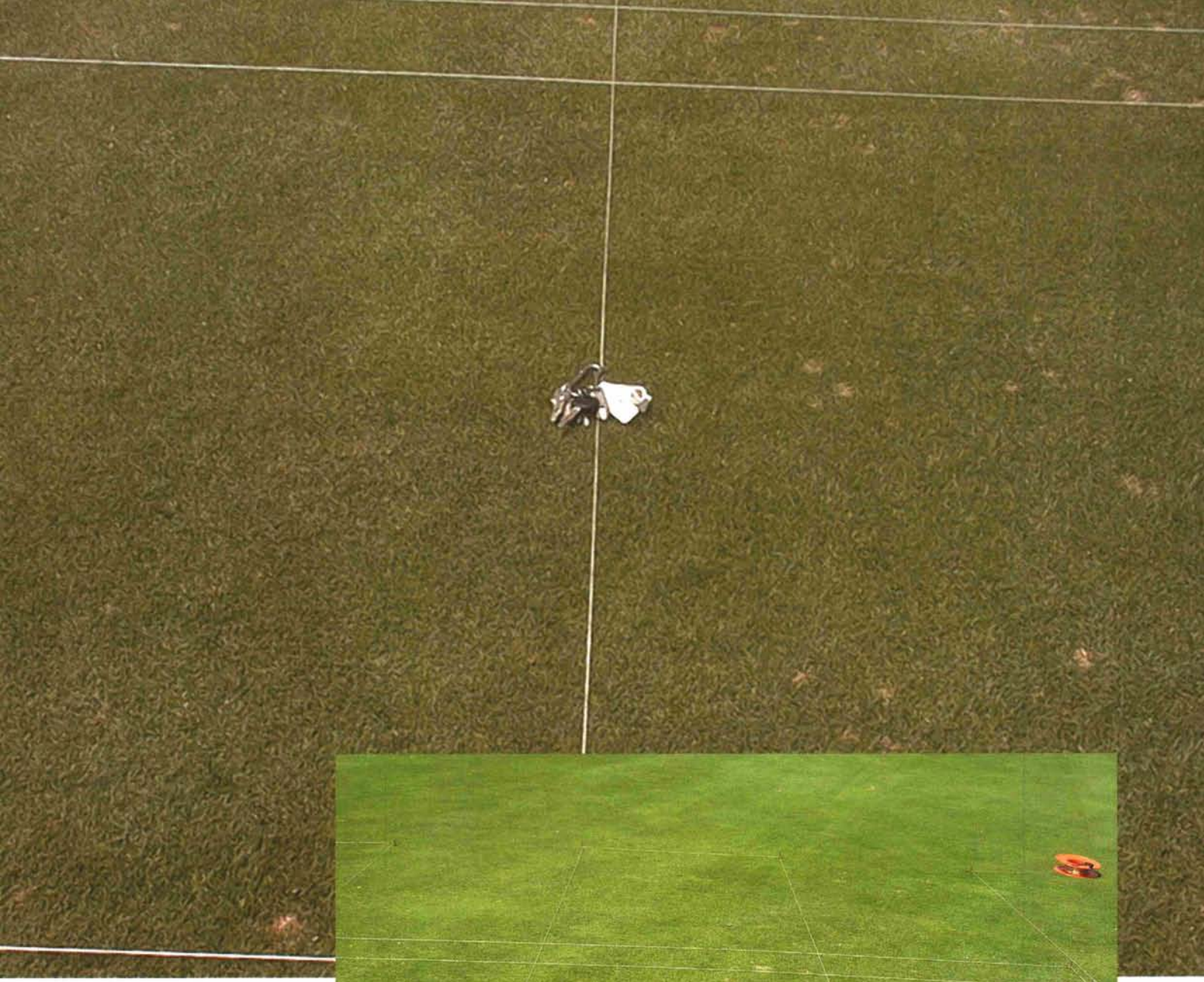

Photo 1
6/27/05: This photo shows the difference in dollar spot severity between Emerald (on the left) and Banner+ Daconil (on the right) which were applied on 5/16/05. This result makes sense since the underlying dollar spot population on this bent/Poa fairway is DMI resistant.

Photo 2
This photo shows the early breakthrough on some treatments that occurred on June 5th of 2006. The plot shown is the earliest application (April 11th) of Daconil.

DMI Resistant Population – July 5th, 2005 rating

Fungicide	App. Date	Degree Day	Mean $ Spot Severity	LSD
Emerald	April 18th	75	2.25 %	A
Emerald	May 10th	151	2.75 %	AB
Emerald	May 16th	185	3.25 %	AB
Bayleton	May 16th	185	6.75 %	ABC
Bayleton	May 10th	151	7.25 %	ABCD
Emerald	April 11th	53	7.75 %	ABCDE
Daconil	April 18th	75	8.5 %	ABCDE

Table 3

The level and types of fungicide resistance must be taken into account before embarking on an early application strategy. For the most part, DMI fungicides did not perform very well when applied early at a DMI resistant site (although Bayleton did perform fairly well at NSCC). However, when applied early at a site with sensitive dollar spot (MGH), the DMIs performed as well as other fungicides *(See Figures 4 & 5)*.

Turf type can play an integral role in the development of dollar spot. Dollar spot on the NSCC plot occurred much earlier and was much more severe than that experienced on the MGH plots. *Poa annua* is much more susceptible than pure bentgrass, making dollar spot much harder to control no matter what application strategy is employed.

This year, dollar spot started firing up at the NSCC plots over Memorial Day weekend, while the plots at MGH were still clean *(see Photo 1)*. The first two ratings on the NSCC plots have been conducted. True to last year's data, the earliest applied materials (first few weeks of April) seem to be having the hardest time maintaining disease control.

Summation

Getting behind the dollar spot 8-Ball is a bad thing, and early dollar spot strategies are a good way to jump ahead of (or in reality stop) the curve. However, as with all recommendations your particular situation can vary (turf type, spray application, budget, fungicide resistance), and fungicide control lasting for eight weeks or more is still not a plausible expectation.

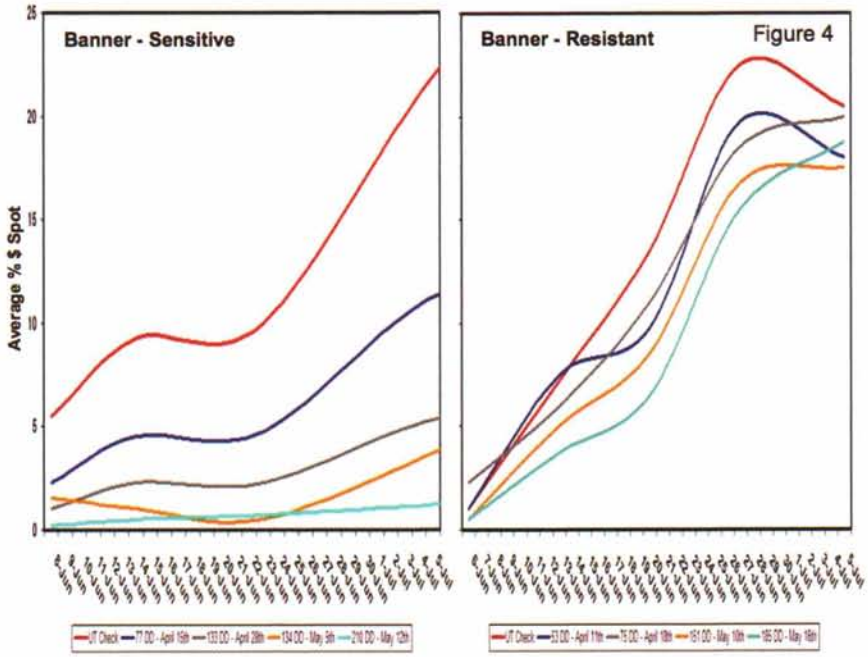

Figure 4
These graphs show that preventative Banner applications work better on DMI sensitive dollar spot populations than on DMI resistant populations.

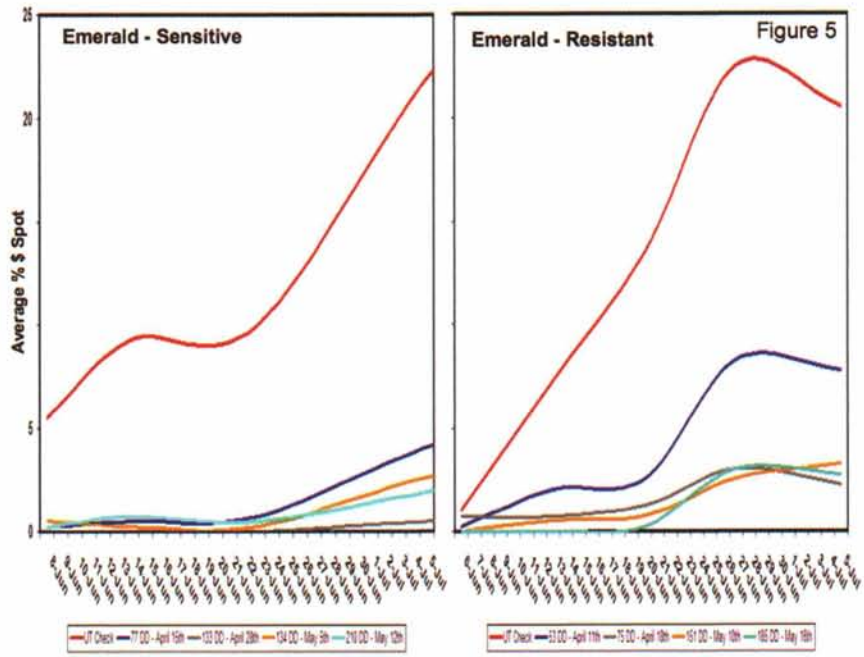

Figure 5
Unlike Banner, Emerald (a non-DMI fungicide) works well on both DMI sensitive and DMI resistant dollar spot populations.

A special thanks to Dan Dinelli, J.D. Dinelli, Chris Bordeleau and the rest of the staff at North Shore for letting me grow dollar spot freely on their #8 fairway. As many of you may already know or will soon see in the Bull Sheet, *I am moving on to pursue my PhD at North Carolina State University.*

Thanks to Randy Kane for his mentorship and all of you that I have learned so much from. I will look back on the time spent here with fond memories. - Lee .