Imagine a Fungicide Program Without Chlorothalonil

By Dr. Jim Kerns, *Department of Plant Pathology, University of Wisconsin - Madison*

During this age of increasing regulations and governmental oversight, it is not difficult to imagine that chlorothalonil's fate is up in the air. Do not be alarmed the EPA has not banned chlorothalonil or even mentioned a ban, but eventually chlorothalonil may be more restricted or even removed from the market. What would your fungicide programs look like? Would the thresholds for disease change? You are probably wondering why I even make these statements and there are two reasons: chlorothalonil is a likely carcinogen (2) and chlorothalonil has a high environmental impact quotient field use rating (1). What do these two statements mean?

Likely a carcinogen means there is adequate data demonstrating carcinogenic potential in humans. However, it is not considered a probable carcinogen because there is either no human data demonstrating tumor development (just strong evidence in animals) or the chemical is associated with tumor development in humans (1). The environmental impact quotient (EIQ) is a method developed by the Cornell IMP program to measure the environmental impact of pesticides (2). Basically a value is calculated for each pesticide based on the toxicological, chemical and physical properties of pesticides. The equation incorporates data such as fish toxicity, dermal toxicity, soil half-life, soil loss potential and many other factors. If this is of interest to you, I encourage you to visit the following website for more information: http://www.nysipm.cornell.edu/publications/eiq/.

To determine a field use EIQ value, golf course superintendents would use the following equation: EIQ x % active ingredient x Rate. Although there are other chemicals on the list that have higher EIQ values, they may contain less active ingredient and/or have lower use rates (1). Therefore their field use EIQ value could be lower. Keep in mind that all this information is public and was originally developed for fruits and vegetables. Why do I mention that? In an article or two ago, I talked about exposure to pesticides and how golfer exposure is minimal. However, the turfgrass market does not drive pesticide sales. Thus if chlorothalonil is discontinued in traditional ag-markets, it will also be removed from the turfgrass market. While I do think this is a long way off (partly because fungicide resistance is so widespread in fruit crops), it is still something to keep in the back of your mind.

This is something I frequently think about, especially when I consider a research project. Our goal is to gather enough information about the diseases affecting turfgrasses in Wisconsin, so if chemicals are removed or rendered ineffective we have information to develop new control strategies. This thought is the reason why we are developing a dollar spot forecasting model, examining the basic biology of the dollar spot pathosystem, investigating the relationship between temperatures and appressorial development in the anthracnose pathogen and evaluating alternative timings/programs of fungicide applications for many turf diseases. Since a lot of the research we do is supported by the golf course superintendents of Wisconsin, I thought this would a good opportunity to justify and explain the research projects we are doing.

Dollar spot Forecasting:

Many of you have heard or read about our dollar spot forecasting model. To summarize briefly, we are correlating environmental conditions to dollar spot development in the field. We used statistical methods to develop an equation that predicts the likelihood of dollar spot development and using the equation helps forecast fungicide applications. Understandably dollar spot is not a major problem for most golf course superintendents because fungicides applied on a cal-

endar basis have been very successful thus far. However, imagine if chlorothalonil was not an option, what would you use and when? Chlorothalonil is extremely effective especially when tank mixed with a systemic fungicide, but losing that old buddy may make dollar spot control more difficult.

Not only does the dollar spot model help schedule fungicide applications more accurately, it provides insight into a mysterious pathosystem. While the model promises to answer some key epidemiological questions about the pathosystem, it also opened Pandora's box on the many other questions that require attention. I know you are probably thinking, who cares-just tell me what to do to control the disease. Without the fundamental knowledge of the disease cycle, developing novel disease control strategies are impossible. There is a reason why the only options to maintain acceptable levels of dollar spot control are fungicides. We will continue working out the kinks on our model this summer and if you want an update, I encourage you to attend the WTA Summer Field Day on July 27th!

Basic Biology of the Dollar spot Pathosystem:

If you are wondering what pathosystem means, it refers to the entirety of the disease cycle. In other words, we are examining the biology of fungus, epidemiology of the disease and the interaction between the fungus and turfgrass plants. Our research has shown that the dollar spot fungus does not thrive on bare soil. The fungus requires some sort of debris to grow. This information tells us that the fungus is either a good saprophyte or responds to volatiles released from dead tissue (necrotrophic pathogen). Understanding that the dollar spot fungus needs plant tissue, dead or alive, leads us to think that the fungus maybe seed borne as well. The research we are doing definitively demonstrates that this fungus is not a good soil dweller, which leads us to wonder why the organism is so ubiquitous. Currently we are working on developing an assay to determine if the dollar spot fungus harbors itself on turfgrass seed.

The other questions we churned up, still focus on survival of the fungus. Therefore we intend to determine where the fungus survives the winter months. We plan to examine plant tissue, soil, and thatch in order to figure out where the fungus overwinters. To help us answer this question we are attempting to develop a medium that selects for Sclerotinia homoeocarpa. Again why is this important? If the organism is seed-borne than

seed treatments may significantly limit dollar spot development. If it overwinters in plants than we can investigate other means for novel control practices.

Although there are cultivars on the market with significant levels of dollar spot resistance, the rationale behind the resistance is not well understood. The cultivars Declaration and Memorial demonstrate good dollar spot resistance and that resistance seems to be correlated to increased production and size of trichomes (hairs). We plan to expand on this initial research using molecular tools and the vast experience of my colleague Andrew Bent. A new student will be joining my program this fall to investigate the genetics of the interaction between the dollar spot fungus and plants. We will use a model plant system to find genes that could be candidates for dollar spot resistance. Then we can screen existing cultivars to see if they have similar genes. If they do not, then we can work with breeders to develop screens for future cultivars. Resistant cultivars could be a valuable tool to combat turfgrass diseases, especially dollar spot.

Anthracnose epidemiology:

Anthracnose is a scary disease because it can wipe out annual bluegrass and creeping bentgrass under the right conditions. The disease is very difficult to control because the pathogen is an extremely good saprophyte. The fungus does not mind living in the soil or on organic materials for extended periods of time. However once turfgrass plants become stressed, the organism seems to initiate an infection. Fungicide applications may be more appropriately timed if we understood the conditions that favor pathogen infection. This is important because the god of the anthracnose, Dr. Bruce Clarke, recommends a tank mixture of chlorothalonil (Daconil) and fosetyl-Al (Signature), but he recommends starting applications before anthracnose typically develops. Currently anthracnose applications should be considered when nighttime temperatures stay above 68oF for an extended period.

We know the anthracnose pathogen produces appressoria (penetration structures), but the research only examined penetration and infection under a single temperature. The study was phenomenal since it developed the methods to investigate the infective process for the turfgrass anthrac-

nose pathogen. Now we can expand on this research to see how temperature affects the infection process. We plan to see how temperature influences the development of the penetration structure (appressorium) on creeping bentgrass and annual bluegrass plants. Having this information will help us recommend more accurate fungicide timings for anthracnose. We could also couple this information with all the recommendations that Dr. Clarke has developed from his experiments on cultural and chemical practices.

Alternative Fungicide Timings and Programs for Turfgrass Diseases:

We are constantly looking at alternative timings and programs for controlling turfgrass diseases. Some of the timings and programs we are currently examining may sound a little absurd, but again we trying to develop control strategies that minimize pesticide applications. We have expanded on our early-season dollar spot research to obtain season long control of dollar spot. Paul Koch's PhD project is investigating the feasibility of coupling snow mold and dollar spot applications into 4 or 5 applications a year. Both of these projects are yielding some very interesting results! In the future, we plan on using EIQ field use ratings to develop fungicide programs that obtain adequate disease suppression. Along with this experiment, we plan to elucidate the effects of pesticide applications on microbial populations in the soil.

All this information will be necessary to develop strategies to control turf diseases in Wisconsin effectively with minimal inputs. Chlorothalonil may not removed for many years, but at least we will have more information to help the turfgrass managers in Wisconsin and throughout the Upper Midwest. The next time you see a presentation from anyone in the turf group at UW-Madison regarding diseases, keep this question in mind, "Could you manage diseases without chlorothalonil?" This is what we think about as researchers and why we search for fundamental knowledge so feverishly!

References:

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