An upcoming issue which will significantly affect the turf industry, including golf courses, is the Pesticide Data Base project being pushed through the legislature by Tom Dawson and the environmental advocacy groups. This will force superintendents and other turf managers to report ALL of their pesticide purchases and applications, including quantities and type of product, to a central location each year. The real fear is the environmental groups will use the information against the industry, highlighting for example how many pounds of chlorothalonil (Daconil) are used and translating this into ounces of product per child and thus shouldn't the compound be banned? Remember what happened to Alar, probably the least toxic of any substances sprayed on apples, back in the mid '80s, just because the environmentalists found out it was used on most of the crop hence most of the public was "exposed". A related issue is the Food Quality Protection Act of 1996. Under this legislation, many of the commonly used pesticides are being re-reviewed by the EPA using strict guidelines for safety and residue levels. One of the goals is to reduce the amount of pesticide released into the environment. There is real potential here that in order to save iprodione (Chipco 26GT in turf, Rovral for crops) for use on a vegetable crop such as carrots, iprodione could be banned for use on turf in order to meet the goal of reduced pesticide use. We need to be able to document the value of the turf industry to thwart legislative actions which would use turf as a scapegoat.

What's involved in the survey

The most important component for conducting the survey is to secure support. Support begins with involvement from the turf industry, UW/extension personnel, and statisticians. Bob Battaglia from the Ag Statistics Service of the Wisconsin Department of Agriculture, Trade, and Consumer Protection has agreed to assist with the survey. I intend to act as a facilitator, mainly raising funding and coordinating an industry oversight committee for the survey. I have already met with the boards of the majority of the turf-related organizations in the state to discuss their support for the survey. The Wisconsin Landscape Federation has already pledged $10,000 to support the survey, and a private company has pledged another $5,000.

I expect the survey to cost approximately $75,000. My estimate is based on what other states have spent, ranging from a low of $35,000 to a high of over $100,000. Actual costs will depend on how much the Ag Statistics Service can provide in terms of personnel to conduct the survey and analysis, publication/mailing costs for the questionnaires and the final document. Much of the industry can be surveyed using mailed questionnaires. Homeowners will need to be surveyed in person–this segment of the industry cannot be ignored because homeowners possess tremendous political clout and will be a majority of the value of the turf industry (in Ohio, homeowners accounted for nearly 60% of turfgrass expenditures).

Timing

I expect to convene an industry oversight committee before the end of March. We will need to meet with the Ag Statistics Service and define our objectives, or what results we want the survey to show. By autumn, I hope to be able to develop the questionnaire and have it printed and mailed during winter of 1999-2000. Homeowners will be surveyed during spring 2000 when they are most likely to be willing to think about their lawns. If all goes well, the results can be analyzed and compiled during the summer and autumn of 2000, with publication of the results during winter 2000-2001.

What can you do?

As a member of the turf industry, you can state your support for the survey to the organization(s) to which you belong (WTA, WGCSA, NGLGCSA, WLF, WSTMA, WSPA, etc.). Eventually we will need to develop funding for the survey. This could come in the form of donations and fund-raising events – golf outings, sale of merchandise or services, etc. If you have comments or questions about the survey, or would like to help, please contact me. I would like to hear from you. John Stier, UW-Horticulture/UW-Extension, 608-262-1624, or jstier@facstaff.wisc.edu.

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Stobilurins: Who Has Them, Where Do They Come From, and How Do They Work?

By Jeffrey S. Gregos, *Department of Plant Pathology, University of Wisconsin–Madison*

As you know the Turfgrass Disease Diagnostic Lab is involved in fungicide evaluation trials. One of the benefits of performing this work is the opportunity to see what is new in the way of plant pathogen control products. I have been involved in such trials since 1992 and have seen many chemicals years before they were released and also ones that have never made it that far. One of the chemistries that has been tested extensively in recent years has been those belonging to the Strobilurin Family. Currently there is only one member of this family available to the public, but in the next couple of months and years there should be at least four to five members.

By this time most of you are already familiar with one of the members, Azoxystrobin or better known in the turf and ornamental market as Heritage. Produced by Zeneca, this product has proven to be very effective against many diseases and probably the premier controll of basal rot anthracnose. But, do you know how it works, where the original chemistry was derived from, or what other available chemicals are in this family that will be available in the future? In the remainder of this article I will update you on the background of this family and what we should be seeing from the major players in turfgrass disease control in the next couple of years.

History

You may or may not know that this family has some very simple beginnings and is actually modeled after naturally occurring compounds. The original compound was first extracted from *Stobillurus tenacellus*, a basidiomycete that was found living on *Pinus sylvestris* (Scotch Pine) pine cones in Europe. Yes, even fungi find other fungi objectionable and use fungicides to ensure their survival. Several companies have taken on to this example and have fashioned many compounds based on the original compound.

The first company to do work on this chemistry was ICI or better known as Zeneca today. They were shortly followed by BASF and the race to market began. It should also be noted that the original work on these products was initiated in 1982, showing how long it takes to get new chemicals to the market place. Now just about every major agricultural chemical company is pursuing some derivative of the strobilurin chemistry. At time of press, at least four companies had strobilurins in their experimental evaluation program or already being marketed.

Mode of Action

Mode of action can be a vague term meaning the specific site of action (i. e. biochemical pathway) or more generally as the either systemic or contact transportation in the plant. For this article, specific site mode of action is not that important and will only be mentioned that this class of chemical affects the bc1 complex of the mitochondrial respiratory chain. More focus will be put toward explaining how the chemicals are translocated through the plant. Three chemicals will be explained: azoxystrobin (Heritage, Zeneca), kresoxim-methyl (unnamed at print, BASF), and trifloxystrobin (Compass, Novartis).

Azoxystrobin

Azoxystrobin is slowly absorbed into the leaf and within 24 hours about 10% of the chemical is absorbed. Once in the leaf it moves acropetally through the xylem (transported outward and upward from site of penetration). Additionally, azoxystrobin has translaminar movement or movement from the top of the leaf to the bottom of leaf. This provides protection to the entire leaf even if only chemical is applied to the top surface. Root absorption is also possible and due to the acropetal movement it is translocated through the xylem to vegetative parts of the plant.

Kresoxim-methyl

This chemical being investigated by BASF has shown to have similar uptake by the plant as azoxystrobin. Also, like azoxystrobin it has to have some translaminar movement from the upper to lower surface of the plant. Additionally through radioactively labeled studies, movement of the product has been observed through the waxy layers (surface systemic). This type of movement in combination with the translaminar movement has been termed quasi-systemic transport. Currently this product is labeled in Europe on several crops; however it is not know when or if it will be labeled on turf in the United States.

Trifloxystrobin

Trifloxystrobin is a new chemical that may be on the market this summer for use on turf under the trade name Compass. Unlike the last two chemicals it has very little absorption into the plant, with about 2% after 24 hours. But its major mode of transport is similar to that if kresoxim-methyl. Novartis has termed this movement as mesostemic. To simply define mesostemic, it is transported through the waxy layer via superficial vapor movement. It additionally has translaminar movement, but has no movement through the vascular system of the plant.

Resistance

Like any single site fungicide there is a high possibility for resistance. Care should be taken with their use and excessive use should be avoided. Standard management practices should be employed such as rotation. This will ensure that we are able to use this chemistry for many years to come.

In summary, we are at a very important crossroad in turfgrass disease control. This is the first step to new and improved chemistries that have greatly reduced use-rates and are derivatives of naturally occurring chemicals, providing much less impact to the environment and the people who use them.

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Microbes in Turf

***By Dr. Wayne R. Kussow**, Department of Soil Science, University of Wisconsin - Madison*

I was recently asked to review literature that is being distributed to professional turfgrass managers. The more I read, the more perturbed I became, and therein lies the motivation for and the gist of this article.

When you receive literature of this type, the first thing you should do is study the writing style. Ignore the factual material. Establish the motivations of the author and understand where they are coming from and what is their agenda. Here are some things to look for.

Words or phrases with shock value: Examples in the literature I reviewed are "soil is a nutritional desert," "microbial vacuum," and "calls for crisis intervention." These are "wow" statements intended to make you believe that this is must-read material. Sit up straight in your chair and pay close attention.

Weaseling: You're supposed to overlook words such as "could, may, possibly, helps, and aids." Authors use these word to remain intellectually honest, but as the reader you're supposed to overlook them and think in more positive terms such as "will, does, and results in."

Bias: Here's where the author tips you off as to where they're coming from and whether or not the article is intended to inform or persuade. There is a big difference between these two objectives. Beware of statements such as "petroleum-based chemicals kill" or the implication that anything "synthetic" is inherently bad.

Inferences: How do you react to the stand-alone statement "Treatment X didn't change the overall microbial population but the type of organisms were very different?" You're supposed to conclude that the product used in treatment X should not be used even though its effects were not what the author anticipated. Unless the author offers evidence that the shift in the populations of different groups of microbes had adverse effects, you've fallen into a trap.

History vs reality: There is a strong tendency among authors with certain biases to quote or reference historical events that reflect badly on something. In these cases, you have to ask yourself the question "When and what were the circumstances under which this undesirable event occurred and are they relevant today?" Very often, the answer is "No." The products referenced and how they were used and on what crops may not pertain to turf at all. In many respects, turf is unique and cannot be thought of in the same vein as agronomic or horticultural crops.

Chicken and egg: The issue here is what came first and what is a cause versus an effect. Take the statement "Killing off fungi favors bacteria, causing soil to become alkaline." Bacteria do not cause soils to become alkaline. Rather, they tolerate high soil pH better than do fungi. Changing soil pH causes shifts in microbial populations. Shifts in microbial populations do not change soil pH.

Warm, fuzzy words: Examples are " balanced and harmonious." To a large extent, these are merely concepts that have eluded clear definition and quantification. They sound good but have little or no util-

ity in turf management.

Extremes as the norm: Be on the lookout for words such as "...there can be as much as..."

The author is stating an extreme value that cannot be interpreted as the normal situation. Take as an example a situation in which one researcher has found a 40% increase in something due to a treatment, but several others have found the response to the same treatment to be in the range of 1 to 10%. The 40% figure is not the norm.

Now I'll examine a number of specific claims often made in the type of literature that has me upset. Let's start with quotations of the numbers of microorganisms in thatch, soil, or the rhizosphere (the soil immediately surrounding plant roots). Approach these numbers with great caution. Burgess and Raw (1967) have clearly stated that it would be surprising if more than 1 cell in 10 or even 1 in 100 that is actually in soil is detected given the current methodology by which they are counted. Tate (1995) reinforces this in his book and further points out that the isolation of a particular organism means that it was present in the soil sample but not that it contributed to the microbial activity of the soil at the time of sampling. It sounds impressive to say that application of an organic fertilizer increased bacteria counts by 7 million, but his number may be in error by 300% and may not have relevance in the field.

Even if we place some faith in the numbers of organisms detected, it is very difficult to interpret what they mean. As stated by Sparling (1997), "Current knowledge is such that there are no accepted or reference values." We simply do not know how numbers of microbes relate to turfgrass growth, what , if any, are the optimum populations, and whether or not there are benefits to having a certain balance among the numbers of bacteria, fungi, and actinomycetes in soil. Furthermore, even if we could define optimum populations, these optima would have to be different for different soils, simply because there are inherent soil properties that regulate microbe populations and activity and these properties vary from one soil to another.

How many times have you read that fertilizers and, in particular, the "synthetic" fertilizers kill soil microorganisms? There probably exist instances in the past where inappropriate uses of chemical fertilizers were observed to adversely affect microbe populations in soil. In response to allegations that this continues yet today, let me quote from Couch (1995). He presents in his book data from several experiments and, from this, concludes that "...inorganic, synthetic organic, and natural organic fertilizers used in accordance with the manufacturer's suggested rates and application schedules have the same impact on the incidence and severity of disease and the same effect on micro-

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bial activity in the thatch and soil." Need I say more?

Pesticides kill soil microorganisms. Of course they do. If they don't, then we're at a loss as far as control of soil-borne pathogens are concerned. But, is it true that every time a pesticide is applied, there are adverse effects on non-target soil microbe populations? Absolutely not. Such a global statement is irresponsible. Take, for example, the work of Harman et al. (1997). They made multiple applications of seven commonly used fungicides at the maximum legal rates and found that the fungicides had little or no effect on microbe populations. It is not universally true that pesticides reduce soil microbial activity. Some do, but others do not. Some even increase microbial activity (Nelson and Craft, 1997).

There is the assertion that acceptable quality turf can be maintained in an all-natural way. There is some very exciting research being done on biological control of turf diseases and this needs to be very intensively investigated. But, we have not yet arrived at the point where golf turf diseases can be biologically controlled to the extent that use of fungicides is not needed (Nelson and Craft, 1997). Therein lies the current dilemma finding combinations of biological and chemical controls that are compatible and can be used together in an integrated disease control program.

Would you believe the statement that "Plants obtain almost all of their nutrients through the help of beneficial organisms working in and around the plants roots?" I hope not. I'd be foolish to dismiss the importance of microbes in plant nutrition, but the above statement goes too far. The role that soil organisms play in plant nutrition varies substantially from one nutrient to another, and there are instances where microorganisms provide unwanted competition with plants for nutrients. No one disputes the importance of soil organisms when it comes to nutrients such as nitrogen. But, there are numerous instances where the role they play is minuscule. A case in point is phosphorus. It is a generally accepted idea that in temperate climates plants rely very little on organic soil P and its microbial release to plants (Anderson, 1980).

Now for the final issue, that of the role that microbes play regarding soil structure. It has been stated over and over again that soil microorganisms form soil aggregates, thereby alleviating soil compaction, increasing water infiltration and favoring root penetration. The truth of the matter is embodied in the statement made by Elliot (1997). "Production of soil organic matter, including extracellular polysaccharides and other cellular debris, increases the capacity of soil to maintain soil structure once it is formed". How structure forms in soil is a poorly understood phenomenon, primarily because it is such a long term process that is not easy to study. A common perception is that the starting point is the physical rearrangement of soil minerals that brings them in close enough proximity to one another so that gummy microbial and plant produced substances can bind them together. These substances, in and of themselves, do not cause soil structure to form. They stabilize existing structures and do so only temporarily. The binding agents themselves are food for other microbes.

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