

DMI RESISTANT UPDATE
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RESISTANCE TO BAYLETON, RUBIGAN, AND BANNER

We have now found strains of *S. homoeocarpa* that are resistant to the DMI fungicides (DeMethylation Inhibiting) Bayleton, Rubigan, and Banner. The development of this resistance has been quite different from resistance to Tersan 1991 or Chipco 26019 in a couple of ways. The occurrence of resistance to the DMI fungicides by *S. homoeocarpa* has been slower and occurred over many years. Resistance to fungicides like Tersan 1991 usually occurred the first or second year the products were used. Resistance to Tersan 1991 was complete; it was a high level of resistance, meaning that increasing the fungicide rate would not overcome the problem.

Resistance to the DMI fungicides has occurred more slowly. It is just beginning to show up now, after over 10 years of using some of the fungicides like Bayleton. Since the resistance to the DMI fungicides has taken so long to develop, it has lulled us to sleep, and given us a false feeling of security leading us to believe that it would never occur.

The second difference is that the resistance by *S. homoeocarpa* to Bayleton, Rubigan, and Banner initially is not as complete as the resistance to Tersan 1991. Initially it expresses itself as shorter intervals of control and/or as incomplete control, in which all of the dollar spot does not disappear after treatment. When it initially occurs in this manner we refer to it as reduced sensitivity rather than true resistance.

HOW RESISTANCE IS EXPRESSED

Reduced sensitivity, instead of the complete resistance that we experienced with the benzimidazole fungicides, has lead some people to mistakenly attribute the shorter intervals and incomplete control to changes in cultural practices. These include the use of less nitrogen to encourage creeping bentgrass over annual bluegrass, and the collecting of clippings on fairways which also reduces nitrogen levels.

UNDERSTANDING RESISTANCE

This reduced sensitivity by *S. homoeocarpa* to DMI fungicides like Bayleton, Rubligan and Banner, unlike true or high level resistance, to Tersan 1991, Fungo 50 or Clearys 3336, could be controlled if higher rates of the DMI fungicides were used. However, following this tactic will soon turn a golf course with DMI reduced sensitivity strains of *S. homoeocarpa* into one with true resistant strains.

Hopefully, one of the things we have learned about resistance over the past few years is that the best way to prevent or delay it from occurring is by using the lowest effective rate of the fungicide to manage the disease and having the longest possible interval between treatments. Conversely, the quickest way to develop a strain which is resistant to a particular fungicide is to use excessively high rates of the fungicide and to shorten the intervals between treatments.

MULTI-RESISTANCE

The most frightening discovery about all of this is that some of the strains of *S. homoeocarpa* with the highest level of resistance to the DMI fungicides also have resistance to benzimidazole type fungicides (Tersan 1991, Fungo 50, and Clearys 3336), and to the dicarboximide fungicides (Chipco 26019 and Vorlan). In other words, they have multiple resistance to three different groups of fungicides. In our field trials only Daconil 2787 at a 6 oz per 1000 sq ft rate and Dyrene at a 4 oz per 1000 sq ft rate applied on a 10 day basis, gave complete control of the multi-resistant strain of *S. homoeocarpa*.

HOW TO DELAY RESISTANCE

In order to delay resistance we need to develop some creative programs to prevent DMI resistant dollar spot from occurring. First let us dispel some myths about preventing resistance from occurring. The old theory that alternating contact and systemic fungicides or applying them together will prevent resistance from occurring will not work. Talk to any superintendent who has DMI reduced sensitivity strains of *S. homoeocarpa* on his golf course and he will tell you he couldn't because he has been alternating or tank mixing contacts and systemic fungicides.

The explanation of why alternating contacts or systemic fungicides or tank mixing them will not prevent resistance from occurring is too involved to cover in this article. It can be summarized, with the fact that through all the years the contact-type fungicides have been used, they have never altered the *S. homoeocarpa* population either through the elimination of wild type strains or the selection and promotion of resistant strains over sensitive strains. Why then, do we expect the contact fungicides to selectively remove the DMI resistant *S. homoeocarpa* strains from the natural population as they develop?

Since most of the problems with resistance to the systemic fungicides has occurred with dollar spot, we need to design a system to delay dollar spot from becoming resistant to the DMI fungicides. By limiting the use of DMI fungicides during the time of year when dollar spot is most severe the selection pressure on the population can be reduced. This should allow the wild-type DMI sensitive strains of *S. homoeocarpa* to remain dominant in the population.

On golf courses where DMI reduced sensitivity strains of *S. homoeocarpa* are not present the following program should be utilized: The DMI fungicides should be used in the spring and early summer for the management of summer patch and take all patch. The contacts (Daconil 2787 and Dyrene), benzimidazoles (Tersan 1991, Fungo 50, and Clearys 3336) and dicarboximide (Chipco 26019 and Vorlan) fungicides should be used for the management of brown patch and anthracnose during the mid summer period, and the DMI fungicides should be used on a three year rotational basis during the time of year when there is heavy dollar spot pressure. This will hopefully delay the appearance of DMI resistant strains of dollar spot.

On golf courses that already have DMI reduced sensitivity strains of *S. homoeocarpa* the following program should be used to delay the development of truly resistant strains. The program incorporates the use of the DMI fungicides in the spring and early summer for summer patch and take all patch management. It incorporates the use of benzimidazole and/or contact fungicides for the management of

brown patch and anthracnose, but eliminates the use of the DMI fungicides when the incidence of dollar spot is most severe. This will hopefully put minimal pressure on the wild type dollar spot population and allow it to remain dominant in the population.

How effective will these strategies be in preventing or delaying resistance? Only time will tell. Research is currently underway to test these strategies. The one thing that we do know is that alternating DMI fungicides with contact fungicides or applying DMI fungicides and contacts together will not prevent or delay the development of resistance. Unfortunately, because these two theories have been so widely accepted as fact, we are once again beginning to experience the widespread occurrence of resistance by S. homoeocarpa to another important group of fungicides, the DMI's.

Because these strains of S. homoeocarpa have resistance to Tersan 1991, Fungo 50, Clearys 3336, Chipco 26019, Curlan and Vorlan, as well as to Bayleton, Rubigan, and Banner, they may pose the most difficult resistance problem we have yet had to deal with.