

# Fungicides: What You Should Know

## Part II: Formulations and Topical Modes of Action

By Jeff Gregos, TDL, Department of Plant Pathology, University of Wisconsin-Madison

In the previous issue formulations and topical modes of action were discussed. This article will include information on the topics of host pathogen interactions and fungicides families. After reading this installment you will be able to make proper decisions on selecting chemicals based on their topical mode of action and fungicide family in relation to the specific type of disease you are trying to manage. It will also give you background information required for developing disease resistance management regimes, which will be discussed in Part III. Enjoy Part II, and if you ever have questions on fungicides, I am only an e-mail or a phone call away.

### Host-pathogen interactions

When selecting a fungicide it is best to think about the pathogen that you are trying to control. All pathogens in turf have different life cycles and infect the turf on different parts of the plant. For example, you know that contact chemicals provide a barrier on the outside of above ground parts of the plant. If you are trying to battle a disease such as summer patch, which is a root infecting disease, contact chemicals will provide little or no protection against such diseases. A better choice would be a chemical that has some type of systemic activity. It happens that the best chemicals for the control of summer patch are in the acropetal systemic group. Also, efficacy is increased when the fungicide is watered in immediately after application.

In figure 7 and table 2 are a list of common infection centers of turfgrass diseases and what type of topical mode of action will provide the best protection against such invasion sites.

### Chemical Families

Chemical families are very important when it comes to developing resistance management programs. When fungal resistance develops to one chemical family, usually the fungus will have resistance to all the chemicals in that family. The previous statement is true because chemicals in the same family have similar biochemical modes of action. Below are the 10 chemical families currently labeled on turf. Under each family is some information about the families including, family members, topical and biochemical modes of action, resistance risk and spectrum of activity according to fungi families. Also included in table 3 (page 9) are common names, trade names, family, mode of action and resistance risk are provided for quick reference.

#### *Aromatic Hydrocarbons*

##### Family members:

Chloroneb, Ethazole, PCNB

##### Topical mode of action:

Contact

##### Biochemical mode of action:

Inhibits DNA synthesis, blocks

activity of respiratory enzymes and prevents development of cell wall membranes

##### Resistance risk:

Low, due to several biochemical modes of action

##### Spectrum of activity\*:

Limited (Basidiomycetes and Oomycetes) PCNB does have activity against some other fungi families, but is primarily used for snow mold control in Wisconsin due the possibility of phytotoxicity at higher air temperatures.

#### *Benzimidazoles*

##### Family members:

Thiophanate Methyl, (Benomyl, no longer produced for turf)

##### Topical mode of action:

Acropetal Systemic

##### Biochemical mode of action:

Interferes with mitosis

##### Resistance risk:

High (Already documented in turf for dollar spot)

##### Spectrum of activity\*:

Broad (Ascomycetes, and Basidiomycetes)

#### *Carbamates*

##### Family members:

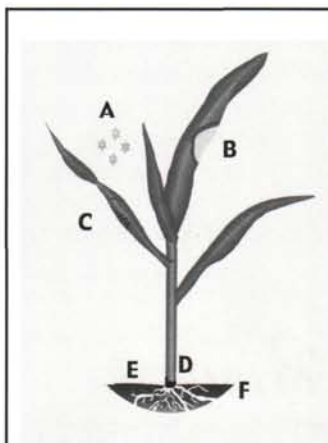


Table 2. Selecting the best topical mode of action for the type of infection.\*\*

	Infection Type	Best*	Adequate*
A	Spores	C	L, M, A
B	Leaf Blights	C, L, M, A, S	
C	Leaf Spots	C, L	M, A
D	Crown Rots	A, M, L	C
E	Root Rots	S, A	L
F	Patch Diseases	A	L

\*Topical modes of action: C = Contacts, L = Local Penetrants, M = Mesostemics, A = Acropetal systemics, and S = Systemics  
 \*\* These are generalizations, please read the label for specific diseases that each chemical is effective against.

Figure 7. Common ways pathogens infect turfgrass plants



Thiram, Mancozeb, Propamocarb

**Topical mode of action:**

Contact, Local Penetrant (propamocarb)

**Biochemical mode of action:**

Inhibits cell enzyme activity or alteration of fatty acid composition

**Resistance risk:**

Low

**Spectrum of activity\*:**

Broad (Basidiomycetes, Ascomycetes, and Oomycetes)

*Carboximides*

**Family members:**

Flutolanil

**Topical mode of action:**

Acropetal Systemic

**Biochemical mode of action:**

Interferes with respiration

**Resistance risk:**

Low, due to the pathogens that it is active on.

**Spectrum of activity\*:**

Limited (Basidiomycetes)

*Demethylation Inhibitors (DMI)*

**Family members:**

Fenarimol, Myclobutanil, Propiconazole, Triadimefon

**Topical mode of action:**

Acropetal Systemic

**Biochemical mode of action:**

Restricts the development of cell membranes

**Resistance risk:**

Medium (Multi-step process, already documented in turf on dollar spot)

**Spectrum of activity\*:**

Broad (Ascomycetes and Basidiomycetes)

*Dicarboximides*

**Family members:**

Iprodione, Vinclozolin

**Topical mode of action:**

Local Penetrant

**Biochemical mode of action:**

Interferes with respiration

**Resistance risk:**

High (Already documented on turf on dollar spot and Microdochium patch)

**Spectrum of activity\*:**

Broad (Ascomycetes and

Basidiomycetes)

*Nitriles*

**Family members:**

Chlorothalonil

**Topical mode of action:**

Contact

**Biochemical mode of action:**

Disrupts cell functions via several methods

**Resistance risk:**

Low, due to several site of action

**Spectrum of activity\*:**

Broad (Ascomycetes and Basidiomycetes)

*Phenylamides*

**Family members:**

Mefenoxam

**Topical mode of action:**

Acropetal Systemic

**Biochemical mode of action:**

Inhibits ribosomal RNA synthesis

**Resistance risk:**

High (Already documented on turf on Pythium blight)

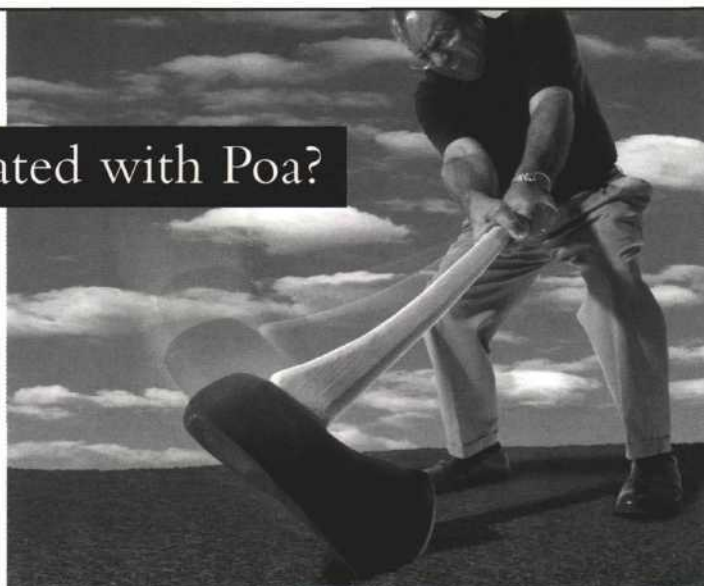
**Spectrum of activity\*:**

Limited (Oomycetes)

*Phosphates*

**Family members:**

## Frustrated with Poa?



### Strike Back with TRIMMIT® 2SC Plant Growth Regulator.

When you have an ax to grind with *Poa annua* in your greens, tees and fairways, strike back with TRIMMIT® plant growth regulator. TRIMMIT in a turf management program will effectively reduce *Poa annua*.

As the best Poa management tool available to golf course superintendents, TRIMMIT:

- Slows grass growth for up to two months after application
- Reduces mowing up to 50 percent
- Minimizes clippings
- Enhances turf color and quality
- Reduces the potential for scalping

The next time you're frustrated with Poa, come down hard with TRIMMIT—and strike it rich in your management program.

For more information, contact your authorized Zeneca Agent, or call Zeneca Professional Products Toll Free at 1-888-617-7690. Labels and MSDSs available 24 hours a day, seven days a week via Fax on Demand. Please call 1-800-640-2362.

[www.zenecaprofprod.com](http://www.zenecaprofprod.com)

Contact:

[Jim.Shone@agna.zeneca.com](mailto:Jim.Shone@agna.zeneca.com)

**Trimmit® 2SC**  
plant growth regulator for turf



#### ZENECA Professional Products

Always read and follow label directions carefully.

TRIMMIT® is a registered trademark of a Zeneca company.

© 2000 Zeneca Ag Products Inc.

Zeneca Professional Products is a business of Zeneca Ag Products Inc.

ZPP-TRI-002

Fosetyl Al

**Topical mode of action:**

Systemic

**Biochemical mode of action:**

Induces defense mechanisms within the plant

**Resistance risk:**

Medium

**Spectrum of activity\*:**

Limited (Oomycetes)

*Strobilurins*

**Family members:**

Azoxystrobin, Trifloxystrobin

**Topical mode of action:**

Acropetal Systemic, Mesostemic

**Biochemical mode of action:**

Reduces production of ATP

**Resistance risk:**

Medium

**Spectrum of activity\*:**

Broad (Ascomycetes, Basidiomycetes, and Oomycetes)

\*Some diseases caused by the pathogens in the families listed under spectrum of activity:

Ascomycetes: Leaf spots, dollar spot, Microdochium patch or pink snow mold, anthracnose, take-all patch, summer patch, and necrotic ring spot

Basidiomycetes: Brown patch, Typhula blight, fairy rings, and red thread

Oomycetes: Pythium blight and yellow tuft

Literature Cited:

Vargas, J. M. Management of Turfgrass Disease. 1994. Lewis Publishers.

Couch, H. Disease of Turfgrass 3rd Edition. 1995. Krieger Publishing Company.

Illustrations on host-pathogen interactions was adapted from the following publication:

Heritage Fungicide. Zeneca. Pub# 10/99 20M ZPP-HER-051

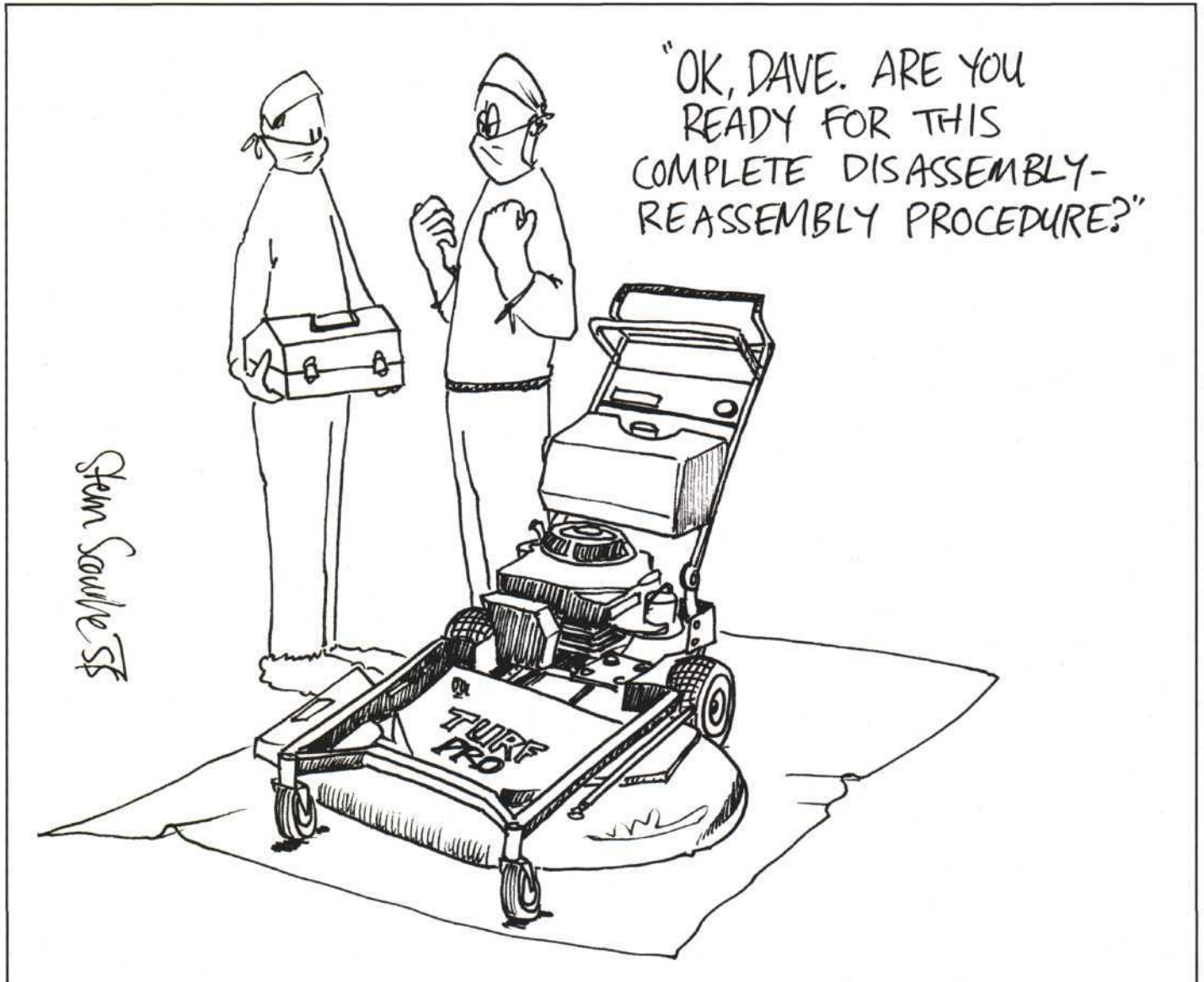




Table 3. Fungicides, common and trade names, family, mode of action and resistance risk

Common Name	Some Trade Names	Family	Topical Mode of Action	Resistance Risk
Azoxystrobin	Heritage	Strobilurin	Acropetal Systemic	Medium
Chloroneb	Terraneb SP	Aromatic hydrocarbon	Contact	Low
Chlorothalonil	Daconil 2787, Daconil ZN, Daconil Weatherstik, Daconil Ultrex, Manicure 6 Flowable, Manicure T&O, Manicure Ultrex, Thalonil 4L, Thalonil 90DF, Echo 720, Echo 75	Nitrile	Contact	Low
Ethazole	Terrazole, Koban	Aromatic hydrocarbon	Contact	Low
Fenarimol	Rubigan A. S.	DMI	Acropetal Systemic	Medium
Flutalonil	Prostar 70 WP	Carboximide	Acropetal Systemic	Low
Fosetyl-Al	Aliette Signature, Aliette T & O, Aliette WDG, Prodigy	Phosphate	Systemic	Medium
Iprodione	Chipco 26019, Chipco 26 GT	Dicarboximide	Local Penetrant	High
Mancozeb	Dithane T/O, Dithane WF, 4 Flowable Mancozeb, Fore, Fore Flo, Mancozeb DG, Junction	Carbamate	Contact	Low
Mefenoxam	Subdue Maxx	Phenylamide	Acropetal Systemic	High
Myclobutanol	Eagle, Golden Eagle	DMI	Acropetal Systemic	Medium
PCNB	Engage 10G, Engage 75W, Revere 4000, Revere 10G, Terraclor 400, Terraclor 75WP, Turfcide 400, Turfcide 10G, FF II, PCNB 12.5 G	Aromatic hydrocarbon	Contact	Low
Propamocarb	Banol	Carbamate	Local Penetrant	Low
Propiconizol	Banner, Banner Maxx	DMI	Acropetal Systemic	Medium
Thiophanate-methyl	Fungo Flo, Fungo 50, 3336 WP, 3336 Flo, Caviler 2G, Caviler 4.5 F, Caviler 50 WSB, Pro Turf Systemic Fungicide	Benzimidazole	Acropetal Systemic	High
Thiram	Spotrete, Thiram	Carbamate	Contact	Low
Triadimefon	Bayleton 25, Bayleton 50, Accost 1G, Granular Turf Fungicide	DMI	Acropetal Systemic	Medium
Trifloxystrobin	Compass	Strobilurin	Mesostemi c	Medium
Vinclozolin	Curalan, Curalan DF, Touché EG, Touché Flowable, Vorlan DF	Dicarboximide	Local Penetrant	High