

# Families of Fungicides for Turfgrass

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[turfdisease.osu.edu](http://turfdisease.osu.edu)

Common Name	FRAC Code <sup>2</sup>	Trade Names <sup>1</sup>	Mode of Action	Uptake and/or Mobility	Concern Over Resistance	Comments
<b>Chemical Family: Dithiocarbamates</b>						
Mancozeb	M3	Fore, Mancozeb, Dithane T/O, Protect T/O	general	contact (no uptake into the tissue)	low	These types of fungicides have broad-spectrum control properties and are used as protectants. Early development of these started in the 1930's.
Thiram	M3	Spotrete, Defiant, Thiram				
<b>Chemical Family: Nitriles/Benzonitriles/Chloronitrile</b>						
Chlorothalonil	M5	Daconil, Manicure, Pegasus, Echo, QP Chlorothalonil	general	contact (no uptake into the tissue)	low	Introduced in the late 1960's and now used extensively on many crops worldwide. This chemistry can provide excellent protection for many infectious diseases, but cannot suppress existing infections. Proper application technique is a must. There are no reports of resistance.
<b>Chemical Family: Benzimidazoles</b>						
Thiophanate-methyl	1	Cleary's 3336 T methyl Pro, T-Storm	specific	systemic (upward)	high	This family of fungicides became available in the late 1960's and ushered in the era of systemic fungicides. The development of resistance to the benzimidazoles is a serious problem.
<b>Chemical Family: Dicarboximides</b>						
Iprodione	2	Chipco 26GT, Raven Iprodione Pro, 18 Plus, QP Ipro	specific	local penetrant	moderate to high (not persistent)	The dicarboximides were developed in the mid-1970's. These fungicides have broad-spectrum activity.
Vinclozolin	2	Curalan				
<b>Chemical Family: Sterol Inhibitors (SI)/Demethylase Inhibitors (DMI)</b>						
Fenarimol	3	Rubigan	specific	systemic (upward)	high	This group of fungicides was introduced in the late 1970's and has broad-spectrum activity. At times, referred to as the SI's or DMI's. The development of resistance to this family of fungicides is a problem.
Myclobutanil	3	Eagle, QP Myclobutanil				
Triademefon	3	Bayleton, Accost				
Propiconazole	3	Banner MAXX, Spectator, ProPensity, Kestrol, ProPimax, QP Propiconazole				
Triticonazole	3	Trinity, Triton				
Metconazole	3	Tourney				
Tebuconazole	3	Torque, Mirage				
<b>Chemical Family: Carboxamides/Anilides/Succinate Dehydrogenase Inhibitors (SDHI)</b>						
Flutolanil	7	ProStar	specific	systemic (upward)	low	The products listed have similar target sites; however, they are typically used to manage different diseases. Newer materials are active on a broad range of turfgrass diseases.
Boscalid	7	Emerald	specific	systemic (upward)	moderate	
Fluxapyroxad	7	Xzemplar	specific	systemic (upward)	moderate	
Penthiopyrad	7	Velista	specific	systemic (upward)	moderate	
Isofetamid	7	Kabuto	specific	systemic (upward)	moderate	
<b>Chemical Family: Strobilurins</b>						
Azoxystrobin	11	Heritage	specific	systemic (upward)	high	Azoxystrobin was introduced in 1997 and the chemical structures was produced by various naturally-occurring, wood-decaying fungi. Strobilurins are broad spectrum disease management tools.
Trifloxystrobin	11	Compass	specific	local penetrant	high	
Pyraclostrobin	11	Insignia	specific	local penetrant	high	
Fluoxastrobin	11	Disarm, Fame	specific	systemic (upward)	high	
<b>Chemical Family: Phenylpyrrole</b>						
Fludioxonil	12	Medallion	specific	local penetrant	low to moderate	Enters the turf plant and is translaminar; it moves from one leaf surface to the other side of leaf. Does not move in the xylem.
<b>Chemical Family: Aromatic Hydrocarbons</b>						
PCNB or Quintozene	14	Terraclor, Turfcide, Revere, FFII, PCNB, Defend, Engage	general	contact (no uptake into the tissue)	low	PCNB is usually considered to be a protectant but may be locally systemic. Considerable label changes are occurring at this time
<b>Chemical Family: Polyoxin</b>						
Polyoxin D zinc salt	19	Endorse, Affirm	specific	local penetrant	moderate	The fungicide enters the plant tissue and accumulates in the waxy cuticle and has translaminar movement. Polyoxin D can suppress existing fungal infections.
<b>Chemical Family: Pyridinamine</b>						
Fluazinam	29	Secure	general	contact (no uptake into the tissue)	low	A new, contact, multi-site, broad spectrum fungicide introduced in to other crops in the 1990's and turf in 2012.

*(continued on back for – Pythium / Oomycete materials and Combination fungicide products)*



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Oomycete (Pythium) Fungicide: The following are used for Pythium and water molds.

Common Name	FRAC Code <sup>2</sup>	Trade Names <sup>1</sup>	Mode of Action	Uptake and/or Mobility	Concern Over Resistance	Comments
<b>Chemical Family: Phenylamide</b>						Few diseases besides those caused by Pythium species or closely related water molds (Oomycetes) like yellow tuft, are controlled. Azoxystrobin (Heritage) and Pyraclostrobin (Insignia) have unique activity against both Pythium species (Oomycetes) and true fungi. Fosetyl-aluminum is a true systemic exhibiting both upward and downward movement in plants. It is also unique in that it moves in the phloem (symplastic transport) as compared to all other systemic fungicides that are transported in the xylem (apoplastic transport).
Mefenoxam	4	Subdue MAXX, QP Mefenoxam Apron (seed treatment)	specific	systemic (upward)	high	
<b>Chemical Family: Strobilurins</b>						
Azoxystrobin	11	Heritage	specific	systemic (upward)	moderate to high	
Pyraclostrobin	11	Insignia	specific	local penetrant	high	
Mandestrobin	11	Pinpoint	specific	systemic (upward)		
<b>Chemical Family: Aromatic Hydrocarbins</b>						
Chloroneb	14	Teremec SP	general	contact (local penetrant)	low	
Ethazole (Etridiazole)	14	Koban, Terrazole, Truban	general	contact	low	
<b>Chemical Family: Cyanoimidazole</b>						
Cyazofamid	21	Segway	specific	local penetrant	moderate to high	
<b>Chemical Family: Carbamate</b>						
Propamocarb	28	Banol	not well known	systemic (upward)	low	
<b>Chemical Family: Phosphonate</b>						
Fosetyl-Aluminum	33	Prodigy, Chipco Signature, Autograph, QP Fosetyl-A1	not well known	systemic (up & down)	low	
phosphite (salts of phosphorous acid)	33	Magellan, Biophos, Resyst, Alude, Vital, Kphite, Fiata, Appear	general	systemic (up & down)	low	
<b>Chemical Family: Benzamide &amp; Carbamate</b>						
Fluopicolide	43+28	Stellar (combined with propamocarb)	general	systemic (upward)	low	

**Combination Fungicide Products**

Product Name (Trade Names)	FRAC Codes	Active Ingredients by Common Names
Armada	(3 + 11)	triadimefon + trifloxystrobin
Briskway	(11 + 3)	azoxystrobin + difenoconazole *
Civitas One	—	synthetic isoparaffin + other ingredients
Concert	(3 + M5)	propiconazole + chlorothalonil
Consan	—	dimethyl benzyl + dimethyl ethylbenzyl, ammonium chlorides
ConSyst, Spectro, Peregrine	(1 + M5)	thiophanate-methyl + chlorothalonil
Daconil ACTION	(M5 + P1)	chlorothalonil + acibenzolar-S-methyl
Enclave	(M5 + 2 + 1 + 3)	chlorothalonil + iprodione + T-methyl + tebuconazole
Exteris	(7 + 11)	fluopyram + trifloxystrobin
Fame +C	(11 + M5)	fluoxastrobin + chlorothalonil
Fame +T	(11 + 3)	fluoxastrobin + tebuconazole
Headway	(11 + 3)	azoxystrobin + propiconazole
Heritage ACTION	(11 + P1)	azoxystrobin + acibenzolar-S-methyl
Honor	(11 + 7)	pyraclostrobin + boscolid
Instrata	(3 + M5 + 12)	propiconazole + chlorothalonil + fludioxonil
Interface	(2 + 11)	iprodione + trifloxystrobin
Junction	(M1 + M3)	copper hydroxide + mancozeb
Lexicon	(7 + 11)	fluxapyroxad + pyraclostrobin
MANhandle	(3 + M3)	myclobutanil + mancozeb
Pillar	(11 + 3)	pyraclostrobin + triticonazole
Prostar Plus	(3 + 7)	triadimefon + flutolanil
Renown	(11 + M5)	azoxystrobin + chlorothalonil
Stellar	(43 + 28)	fluopiolide + propamocarb hydrochloride
Systar	(1 + 7)	thiophanate-methyl + flutolanil
Tartan	(3 + 11)	triadimefon + trifloxystrobin
26/36 Fungicide, Lesco TwoSome	(2 + 1)	iprodione + thiophanate-methyl

\* a new sterol inhibitor / demethylase inhibitor, this is NOT sold as a single material for turfgrass.

**Biocontrol Agents**

Product Name - by Trade Names)	Active Ingredients - by Common Names
EcoGuard	<i>Bacillus licheniformis</i>
Companion	<i>Bacillus subtilis</i> GB03
Rhapsody	QST 713 strain of <i>Bacillus subtilis</i>
TurfShield	<i>Trichoderma harzianum</i> Rifai strain T-22 + <i>Trichoderma virens</i> strain G-41

**FRAC - Fungicide Resistance Action Committee**

FRAC is a Specialist Technical Group of CropLife International

FRAC Code: Numbers and letters are used to distinguish the fungicide groups according to their cross resistance behavior. The numbers were assigned according to the time of product introduction to the market. The letters refer to P = host defense inducers, M = multi-site inhibitors, and U = unknown mode of action and unknown resistance risk. For more information go to - [frac.info/frac/menu.htm](http://frac.info/frac/menu.htm)

For additional information refer to our website: [turf-disease.osu.edu](http://turf-disease.osu.edu)