Families of Fungicides for Turfgrass

Common Name	FRAC Code[2]	Trade Names[1]	Mode of Action	Uptake and/or Mobility	Concern Over Resistance	Comments
Chemical Family: Dithiocarbamates						
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 1930s.
Thiram	M3	Spotrete, Defiant, Thiram				
Chemical Family: Nitriles/Benzonitriles/Chloronitrile						
Chlorothalonil	M5	Daconil, Manicure, Pegasus, Echo, QP Chlorothalonil	general	contact (no uptake into the tissue)	low	Introduced in the late 1960s 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.
Chemical Family: Benzimidazoles						
Thiophanatemethyl	1	3336, thiophanate methyl T methyl Pro, T-Storm	specific	systemic (upward)	high	This family of fungicides became available in the late 1960s and ushered in the era of systemic fungicides. The development of resistance to the benzimidazoles is a serious problem.
Chemical Family: Dicarboximides						
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-1970s. These fungicides have broad-spectrum activity.
Vinclozolin	2	Curalan[3]				
Chemical Family: Sterol Inhibitors (SI)/Demethylase Inhibitors (DMI)						
Fenarimol	3	Rubigan[3]	specific	systemic (upward)	high	This group of fungicides was introduced in the late 1970s and has broad-spectrum activity. At times, referred to as the SIs or DMIs. 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				
Mefentrifluconazole	3	Maxtima				
Chemical Family: Carboxamides/Anilides/Succinate Dehydrogenase Inhibitors (SDHI)						
Flutolanil	7	ProStar, Pedigree	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	
Pydiflumetofen	7	Posterity	specific	systemic (upward)	moderate	
Chemical Family: Strobilurins (QoI)						
Azoxystrobin	11	Heritage	specific	systemic (upward)	high	Azoxystrobin was introduced in 1997 and the chemical structures were 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	
Mandestrobin	11	Pinpoint	specific	systemic (upward)	high	
Chemical Family: Phenylpyrrole						
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.
Chemical Family: Aromatic Hydrocarbons						
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.
Chemical Family: Polyoxin						
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.
Chemical Family: Pyridinamine						
Fluazinam	29	Secure	general	contact (no uptake into the tissue)	low	A new, contact, multi-site, broad spectrum fungicide introduced into other crops in the 1990s and turf in 2012.

(continued on back for Pythium/Oomycete Materials and Combination Fungicide Products)

TurfTrade
517 Franklinville Rd.
Mullica Hill NJ, 08062
856-478-6704
www.TheTurfTrade.com

The following are used for Pythium and water molds						
Common Name	**FRAC Code[2]**	**Trade Names[1]**	**Mode of Action**	**Uptake and/or Mobility**	**Concern Over Resistance**	**Comments**
Chemical Family: Phenylamide						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	
Chemical Family: Strobilurins						
Azoxystrobin	11	Heritage	specific	systemic (upward)	moderate to high	
Pyraclostrobin	11	Insignia	specific	local penetrant	high	
Chemical Family: Aromatic Hydrocarbons						
Chloroneb	14	Teremec SP	general	contact (local penetrant)	low	
Ethazole (Etridiazole)	14	Koban, Terrazole, Truban	general	contact	low	
Chemical Family: Cyanoimidazole						
Cyazofamid	21	Segway	specific	local penetrant	moderate to high	
Chemical Family: Carbamate						
Propamocarb	28	Banol	not well known	systemic (upward)	low	
Chemical Family: Phosphonate						
Fosetyl-aluminum	P7	Prodigy, Chipco Signature, Autograph, QP Fosetyl-A1	not well known	systemic (up and down)	low	
phosphite (salts of phosphorous acid)	P7	Magellan, Biophos, Resyst, Alude, Vital, Kphite, Fiata, Appear	general	systemic (up and down)	low	
Chemical Family: Benzamide and Carbamate						
Fluopicolide	43+28	Stellar (combined with propamocarb)	general	systemic (upward)	low	

[1]Product list by trade name may not be all inclusive. No endorsement is intended for products mentioned or is criticism meant for products not mentioned.

[2]FRAC codes indicate the biochemical target site of action, according to the Fungicide Resistance Action Committee. M3 and M5 indicate multi-site inhibitor, with no significant risk of resistance.

[3]Product no longer manufactured for turfgrass use.

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)	fluropyram* + trifloxystrobin + Stressgard
Fame +C	(11 + M5)	fluoxastrobin + chlorothalonil
Fame +T	(11 + 3)	fluoxastrobin + tebuconazole
Headway	(11 + 3)	azoxystrobin + propiconazole
Honor	(11 + 7)	pyraclostrobin + boscolid
Instrata	(3 + M5 + 12)	propiconazole + chlorothalonil + fludioxonil
Interface	(2 + 11)	iprodione + trifloxystrobin + Stressgard
Junction	(M1 + M3)	copper hydroxide + mancozeb
Lexicon	(7 + 11)	fluxapyroxad + pyraclostrobin
MANhandle	(3 + M3)	myclobutanil + mancozeb
Navicon	(3 + 11)	mefentrifluconazole + pyraclostrobin
Pillar	(11 + 3)	pyraclostrobin + triticonazole
Premion	(14 + 3)	PCNB + tebuconazole
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 + Stressgard
Tekken	(7 + 3)	isofetamid + tebuconazole
Traction	(29 + 3)	fluazinam + tebuconazole
26/36 Fungicide, Lesco TwoSome	(2 + 1)	iprodione + thiophanate-methyl

*This is NOT sold as a single material for turfgrass.

Biocontrol Agents	
Product Name (by Trade Names)	**Active Ingredients by Common Names**
EcoGuard	*Bacillus licheniformis*
Companion	*Bacillus subtillis* GB03
Rhapsody	QST 713 strain of *Bacillus subtilis*
TurfShield	*Trichoderma harzianum* Rifai strain T-22 + *Trichoderma virens* 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/home.