

FUNGICIDES SOLD AS PRE-PACKED MIXTURES

ACTIVE INGREDIENTS	PRODUCT NAMES	ACTIVE INGREDIENTS	PRODUCT NAMES
<i>azoxystrobin + propiconazole</i>	Headway, Contend B	<i>fluoxastrobin + tebuconazole</i>	Fame + T
<i>azoxystrobin + acibenzolar-S-methyl</i>	Heritage Action	<i>fluoxastrobin + miclobutanil</i>	Disarm M
<i>azoxystrobin + chlorothalonil</i>	Renown	<i>iprodione + thiophanate methyl</i>	26/36 Fungicide, ArmorTech TMI 2020, Dovetail, Lesco twosome, TM + IP SPC
<i>azoxystrobin + difenconazole</i>	Briskway	<i>iprodione + trifloxystrobin</i>	Interface
<i>azoxystrobin + tebuconazole</i>	ZoxyT, Strobe T	<i>mefentrifluconazole + pyraclostrobin</i>	Navicon
<i>benzovindiflupyr + difenoconazole</i>	Ascernity, Contend A	<i>myclobutanil + mancozeb</i>	MANhandle
<i>copper hydroxyde + mancozeb</i>	Junction	<i>PCNB + tebuconazole</i>	Oreon, Premion
<i>chlorothalonil + boscalid</i>	Encartis	<i>pydiflumetofen + azoxystrobin + propiconazole</i>	Posterity XT, Posterity Forte
<i>chlorothalonil + propiconazole</i>	Concert, Concert II	<i>pyraclostrobin + boscalid</i>	Honor, Honor Intrinsic
<i>chlorothalonil + propiconazole + PCNB</i>	FF III fungicide	<i>pyraclostrobin + triticonazole</i>	Pillar
<i>chlorothalonil + tebuconazole</i>	E-Scape ETQ	<i>thiophanate methyl + chlorothalonil</i>	Broadcide, ConSyst, Peregrine, Spectro, Tee-1-up WDG, TM + CTN SPC
<i>chlorothalonil + fludioxonil + propiconazole</i>	Instrata, Versagard	<i>thiophanate methyl + flutolanil</i>	Systar
<i>chlorothalonil + thiophanate methyl + iprodione + tebuconazole</i>	Enclave	<i>thiophanate methyl + mancozeb</i>	Duosan
<i>chlorothalonil + acibenzolar-S-methyl</i>	Daconil Action	<i>thiophanate methyl + thiram</i>	Bromosan
<i>fluazinam + acibenzolar-S-methyl</i>	Secure Action	<i>triadimefon + flutolanil</i>	Prostar plus
<i>fluazinam + tebuconazole</i>	Traction	<i>triadimefon + trifloxystrobin</i>	Armada 50WGD, Armada 50WP, Tartan
<i>fluindapyr + trifloxystrobin</i>	Kalida	<i>triticonazole + chlorothalonil</i>	Reserve
<i>fluopyram + trifloxystrobin</i>	Exteris	<i>tebuconazole + isofetamid</i>	Tekken
<i>fluoxastrobin + chlorothalonil</i>	Disarm C, Fame + C		

See labels for rates and specific recommendations

MAJOR CHEMICAL GROUPS OF TURFGRASS FUNGICIDES

CHEMICAL FAMILY	COMMON NAME	TRADE NAME	TYPE/MODE OF ACTION
acylpicolides	<i>fluopicolide</i>	Stellar	Delocalization of proteins
Aromatic Hydrocarbons	<i>chloroneb</i>	Anderson's Fungicide V 6.25G, Anderson's Turf Fungicide 7.5G, Termec SP, Terraneb SP	Protectant Fungicide Mode of action: Interferes with mitosis
	<i>etridiazol</i>	Koban 30WP, Terrazole	
	<i>PCNB</i>	Anderson's 10-0-14 Fertilizer + 15% PCNB, Autilus Anderson's FFII 15 .4G (14-3-3), Cleary's PCNB, Engage 75W, Engage 10GF, FF II, Lesco Revere 4000 4F, Lesco Revere 10G, Parflo 4F, Penstar 75WP, Penstar 15G, Penstar 4F, Revere 10G, Revere 4000, Flowable Turf, Terraclor 75%WP, Terraclor 75%WP (T&O), Turfcide 400F, Turfcide 10G, Oreon, FF III	
Antibiotic	<i>polyoxind</i>	Affirm, Endorse	Localized penetrant fungicide Mode of action: Inhibits chitin production, which is a major component of the cell wall in many fungi; Inhibits spore germination
Benzimidazoles	<i>thiophanate methyl</i>	Anderson's Systemic Fungicide 2.3G, ArmorTech TM 462, Cavalier, Cleary's 3336 50W/WSP, 3336 2G, 3336 4.5F, 3336 GC, 3336 DG Lite, Fungo Flo AGC, Fungo 4.5F, Fungo Flo 50WSB, Lesco T-Storm (50WSP, 2G, Flowable), OHP 6672 (4.5L & 50W), Scott's Lawn Fungus Control, Systec 1998 85WDG, T-Bird 4.5L, T-Bird 85 WDG, T-Methyl SPC 4.5, T-Methyl SPC 50, T-Methyl G, Tee-off 4.5F	Acropetal penetrant Mode of action: Fungicide binds tubulin subunits that results in mitotic arrest
Carboximides (SDHI)	<i>benzovindiflupyr</i>	Part of Ascernity, part of Contend A	Acropetal penetrant fungicide Basidiomycete control Mode of action: Blocks activity of certain respiratory enzymes.
	<i>boscalid</i>	Emerald	
	<i>fluopyram</i>	Part of Exteris	
	<i>flutalonil</i>	Prostar	
	<i>fluxapyroxad</i>	Xzemplar	
	<i>isofetamid</i>	Kabuto Fungicide SC, Tekken	
	<i>penthiopyrad</i>	Velista	
<i>pydiflumetofen</i>	Posterity		
Demethylation Inhibitors (DMI's)	fenarimol	Rubigan	Broad spectrum acropetal penetrant fungicide Mode of action: Sterol inhibitor (ergosterol). Inhibits cell membrane synthesis
	<i>flutriafol</i>	Rayora	
	<i>mefentrifluconazole</i>	Maxtima	
	myclobutanil	ArmorTech Myclo 20 EW, Eagle 20 EW, Eagle 40 WSP, Lesco Eagle G, Lebanon Eagle G, Myclobutanil 20EW T/O	
	propiconazole	ArmorTech PPZ143MC, Banner GL 3.6 WSP, Banner Maxx 1.24 MEC, Lesco Spectator 3.6EC, Lesco Spectator Ultra 1.3 MEC, Monsoon turf, ProPensity 1.3 ME, Propiconazole SPC 14.3, Quali-pro propiconazole 14.3, Strider	

MAJOR CHEMICAL GROUPS OF TURFGRASS FUNGICIDES

CHEMICAL FAMILY	COMMON NAME	TRADE NAME	TYPE/MODE OF ACTION
Demethylation Inhibitors (DMI's) (continued)	prothioconazole	Densicor	Broad spectrum acropetal penetrant fungicide
	tebuconazole	ArmorTech TEB360, Sipcam Clearscape, Sipcam Clearscape ETQ, Torque, Mirage Stressguard	Mode of action:
	triadimefon	Accost 1G, Anderson's Fungicide VII 0.59G, Anderson's 1% Bayleton 1G, Bayleton 25WP, Bayleton 50WSP, Bayleton Flo, Lebanon Bayleton 1G, Lesco Granular turf fungicide 1G, Lesco Systemic, Pro Bayleton, Strike 25 WP	Sterol inhibitor (ergosterol). Inhibits cell membrane synthesis
	triticonazole	Trinity, Triton	
Dicarboximides	iprodione	ArmorTech IP233, Chipco 26GT, Chipco 26019, Eclipse ETQ, Lesco 18 plus, Iprodione Pro 2SE, Iprodione SPC, Ipro2SE	Localized Penetrant Mode of action: Affects DNA synthesis and lipid metabolism
	vinclozolin	Curalan, Touche	
Carbamates and Dithiocarbamates	mancozeb	Dithane 4SC Rainshield, Dithane 75DF Rainshield, Dithane DF, Dithane DF Rainshield, Dithane F-45 Rainshield, Dithane M-45, Dithane WF Rainshield, Dithane T/O Rainshield 75WP, Dithane 37WF, Flowable Mancozeb 4, Fore, Fore Flo-XL 4F, Fore 80WP Rainshield, Formex 80W, Lesco Mancozeb 75DG, Lesco 4 Flowable Mancozeb 4F, Mancozeb + Copper, Mancozeb DG, Manzate 80WP, Manhandle, ManKocide, Manzate 75DF, Manzate Flowable Protect T/O	Protectant fungicide Mode of action: Enzyme inactivation
	propamocarb hydrochloride	Banol, Lesco Banol, Proplant	Localized penetrant Mode of action: Alters cell membrane function
Nitriles	chlorothalonil	ArmorTech CLT720, ArmorTech CLT825, Anderson's 5% ChloroStar 6F, 82.5WDG, Chlorothalonil 500ZN, 720SFT, DF, Countdown, Daconil 5G, Daconil Action, Daconil Ultrex, Daconil Weatherstik, Daconil Zn, Docket, Echo DF, Echo 500, Echo Ultimate ETQ, Echo 6F ETQ, Echo Dyad ETQ, Evade, 75WDG, Lebanon Daconil 5G, Lesco Manicure T/O, 6F, Legend, Thalonil, Manicure, Manicure Ultra, Pegasus DFX, Ultrex 82.5WDG	Protectant Fungicide Mode of action: Toxic to cell membrane
Phenylamides	mefenoxam	Anderson's Pythium Control 1.2G, Apron XL LS, Mefanoxam 2AQ, Quell, Ridomil Gold EC, Subdue GR, Subdue Maxx, Subdue WSP, Tri-Power Selective	Acropetal penetrant fungicide Mode of action: Inhibits RNA synthesis
Phenylpyrrole	fludioxonil	Medallion	Protectant Fungicide Mode of action: Cell membrane toxicity, amino acids uptake inhibition
phenylpyridnamine	fluazinam	Secure	Protectant Fungicide Mode of action: Inhibits respiration
Phosphonates	fosetyl-a1	ArmorTech ALT70, Aliette 80WP, Aliette WDG, Chipco Signature, Prodigy Signature, Fosetyl-Al 80WGD, Lesco Prodigy Signature 80DG, Terra Aliette T/O, 80WDG	Systemic fungicide
	potassium phosphonate, phosphite	Alude, Appear, Magellan, Phostrol, Vital, Jetphiter	Mode of action: General fungitoxic effect

MAJOR CHEMICAL GROUPS OF TURFGRASS FUNGICIDES			
CHEMICAL FAMILY	COMMON NAME	TRADE NAME	TYPE/MODE OF ACTION
Strobilurins	azoxystrobin	Heritage, Strobe, Strobe 50WG, Strobe 2L	Broad spectrum, systemic
	flouxastrobin	Disarm, Disarm C, Disarm GC, Disarm M	Broad spectrum, systemic Broad spectrum, localized penetrant
	trifloxystrobin	Compass	
	pyraclostrobin	Insignia, Insignia Intrinsic	Mode of action: ATP inhibition
	<i>mandestrobin</i>	Pinpoint	Broad spectrum, systemic

BIOFUNGICIDES

Biofungicides are naturally based microbial or biochemical products. There are two types of biofungicides: (1) Microbial biofungicides with an active ingredient that is a biological control agent (organism capable of attacking or competing with a pathogen or pest), and (2) plant biofungicides or plant-incorporated protectants are “pesticidal substances that plants produce from genetic material that has been added to the plant.”

Biofungicides			
TRADE NAME	ACTIVE INGREDIENTS	RATES (OZS./1000 ft ²)	COMPANY
Companion	<i>bacillus subtilis</i> Strain GB03	4.0-6 fl. oz.	Growth Products
EcoGuard SB 3086	<i>bacillus licheniformis</i>	Up to 20 oz.	Novozymes
Rhapsody Strain QST713	<i>bacillus subtilis</i>	2.0-10 fl. oz.	Agraquest ArmorTech
Sonnet ArmorTech	Bacillus subtilis Strain QST711	0.5-2.4 fl oz	ArmorTech
Double Nickel LC	Bacillus amyloliquefaciens	1-4 fl oz	Certis
Actinovate	Streptomyces lydicus WYEC 108	0.4-0.56 oz	Novozymes
TurfshieldPlus	Trichoderma harzianum Rifai strain T22 Trichoderma viride strain G-41	1-4 lb	BioWorks
Regalia PTO	<i>Reynoutria sachalinensis</i>	Plant Extract. 1.0-3.0 fl. oz.	Marrone BioInnovations/Engage Agro USA
Zio	<i>Pseudomonas chlororaphis</i> strain AFS009	1.8-6.0 oz.	SePro

ADDITIONAL NOTES ON TURFGRASS FUNGICIDES

Protectant and Systemic Fungicides

There are two general types of fungicides: protectants and systemics. Protectant fungicides (sometimes called contacts), remain on the plant surfaces after application and do not penetrate the plant tissue. Systemic fungicides are absorbed into the plant and move within the plant tissue. Some fungicides are locally systemic and move only a limited distance within the plant. The dicarboximide fungicides are good examples of this group. Some systemics are moderately systemic, such as the DMI fungicides, whereas others are highly systemic and move readily through the plant's vascular transport system (e.g., the phosphonates). Examples of highly mobile systemics include the benzimidazoles. Most systemic fungicides only move upward in plant tissues. Only one systemic fungicide (fosetyl-Al) moves bidirectionally (from leaves to roots and vice versa). Systemic fungicides sometimes can suppress the fungus after it has infected the plant, whereas protectant fungicides must be present on the plant surfaces before infection begins to be effective.

Formulation

Several fungicidal products are available in more than one formulation. For protectant fungicides, a sprayable formulation (wetable powder, flowable, dry flowable, water dispersible granule, emulsifiable concentrate) usually provides better disease control than a granular formulation. Sprayable formulations can be superior to granular formulations even for systemics that are not highly mobile in plant tissues. Spray equipment allows more thorough coverage of plant surfaces than does a granular spreader. More thorough coverage can result in better control of fungi infecting foliage. If fungicide sprays are applied to control a root disease, it is often advisable to lightly irrigate before the fungicide dries to wash it into the root zone. Likewise, if granular fungicides are applied to control root diseases, apply to dry turf and irrigate after application.

Fungicide Mixtures

Several products formulated for turf disease control are prepackaged mixtures containing two or more active ingredients. Mixtures provide some protection against fungicide resistance and typically provide a broader spectrum of activity against turfgrass diseases. Prepackaged mixtures offer convenience and assurance against incompatibility, whereas tank-mixing on site offers greater flexibility in fungicide choice and application rates.

Fungicide Resistance

Infectious fungi sometimes develop resistance to particular fungicides, especially when a product is used repeatedly without alternating with chemically unrelated fungicides. When fungicide resistance develops, there is no value in increasing rates, shortening intervals between sprays, or using other fungicides with similar modes of action. Fungicide resistance has been confirmed in numerous instances for each of the following diseases and fungicide groups: dollar spot against benzimidazole fungicides and DMI fungicides (e.g. Bayleton etc.), gray leaf spot against strobilurin (QoI) fungicides (e.g. Heritage, Compass etc), and Pythium blight against phenylamide fungicides (Subdue etc). Benzimidazoles (e.g., Cleary 3336) and phenylamides (e.g., Subdue MAXX) have the highest risk of resistance. Strobilurins (e.g., Heritage) have a moderately high risk of resistance, DMIs (e.g., Bayleton) and the dicarboximides (e.g., Chipco 26GT) have a moderate risk, and the nitriles (e.g., Daconil), aromatic hydrocarbons (e.g., PCNB), and dithiocarbamates (e.g., mancozeb) have a low risk of resistance. Several general strategies are recommended to minimize the risk of fungicide resistance. First, don't rely on fungicides alone for disease control. Avoid using turfgrass varieties that are highly susceptible to common diseases. Follow good disease management practices to reduce the possibility of fungicide resistance. Limit the number of times at-risk fungicides are used during a growing season. Alternate at-risk fungicides with different fungicide groups. When using an at-risk fungicide, tank-mixing it with another fungicide from another chemical group (different mode of action) can also reduce the risk of resistance. These are general principles that can help to reduce but not eliminate risk. A fungicide-resistant pathogen population can still develop when these principles are practiced. Refer to product labels before tank-mixing products to ensure compatibility and to avoid phytotoxicity. For major chemical groups description, see "Major Chemical Groups" section located at the end of this handbook.

Chlorothalonil Restrictions on Residential (Home) Lawns

As a result of the Food Quality Protection Act of 1996, the EPA has decided to curtail the use of fungicides containing chlorothalonil and iprodione on residential turf.

Chlorothalonil Restrictions on Golf Courses

As of 2001, the following restrictions are in effect for the use of chlorothalonil on golf courses:

Seasonal maximum:

-73 lbs. ai/A/season on greens

-52 lbs. ai A/season on tees

-26 lbs. ai/A/season on fairways.

Maximum single application rate: 7.3 lbs. ai/A

Minimum spray intervals: 7 day

Methods to maximize efficacy of turfgrass fungicides

- All fungicides are not equally effective on all diseases. Proper selection is very important on disease management.
- Read the label directions carefully before applying fungicide.
- Apply fungicides at the rate specified in the label.
- Use compatible tank mixes at recommended label rates.
- The best control is achieved by applying fungicides preventatively.
- Fungicides should be sprayed when air temperatures are between 60°F and 85°F (15.3°C and 29.4°C).
- Avoid turfgrass stress (drought or temperature) before or at the time of application.
- Use proper sprayer to deliver appropriate coverage.
- Fungicides should stay on the foliage for at least 6 h for most effective control.
- Some fungicides have to be watered-in for proper place of action.
- Do not apply fungicides if rain is expected within 3-4 h (ideally 12 h after application).
- Delay mowing as much as possible to give the fungicide a chance to work (should follow the one-third rule).
- Use enough water when applying fungicide (usually 2 gallons/1000 ft² will give adequate coverage).
- Water pH for dilution or mix should be between 6-7.
- Do not apply fungicides when conditions are windy. Wind velocity tends to be the lowest early in the morning and late in the afternoon.
- When using granular materials, best results are obtained if soil is moist.
- Keep traffic off the area at least 2-3 hours after application.
- Be patient if an application appears to have produced no results. Some fungicide application results can be seen months later.