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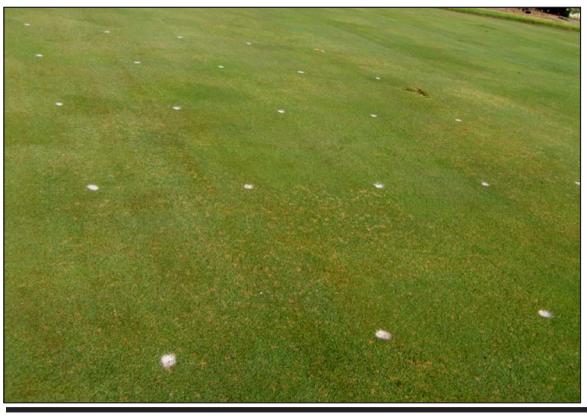

GUIDE TO TURFGRASS FUNGICIDES

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Contents

Guide to Turfgrass Fungicides

Common Turfgrass Diseases and Chemical Controls

Rhizoctonia complex (Brown Patch and Large Patch). Caused by *Rhizoctonia* spp. (mostly *R. solani* in Georgia). The disease can affect all species of warm- and cool-season turfgrasses, including bentgrass, ryegrass, tall fescue (Brown Patch) and St. Augustinegrass, zoysiagrass, centipede and bermudagrass (Large Patch). The most favorable conditions for disease development usually occur from late April through October. Brown patch is favored by high relative humidity during the day and a minimum temperature of 60 degrees F at night. Excess soil moisture, extended leaf wetness and/or high levels of nitrogen increase severity of the disease. **Symptoms:** Leaf blades or sheaths are blighted in circular patches measuring several inches to feet across. In bermudagrass, centipede and ryegrass, patches are brown. In St. Augustinegrass, patches appear straw-colored. Smoke rings may be present in bentgrass. Mycelium may be evident early in the morning.

Disease	Pesticide	Rates (ozs./1000 ft^2)	Remarks
Brown Patch (*Rhizoctonia solani*)	Azoxystrobin (Heritage 50WG, TL, Heritage G)	0.2 to 0.4 oz. at 14 to 28 day intervals 2 to 4 lb at 14-28 days intervals	
	Azoxystrobin _+ propiconazole (Headway)	0.75-3 oz at 14 to 28 days intervals	
	Bacillus licheniformis (EcoGuard SB 3086)	Up to 20 oz at 3-14 days intervals	
	Bacillus subtilis Strain QST713 (Rhapsody)	2.0 to 10 fl oz. at 7-10 day intervals	Apply in sufficient water to provide thorough coverage. 2 gal /1000 ft2 are commonly used.
	Bacillus subtilis Strain GB03 (Companion)	4.0 to 6 fl oz. 14-28 day intervals	
	Chlorothalonil (Concord DF, Concord SST, Daconil Ultrex, Daconil Weatherstik, Daconil Zn, Echo DF, Manicure, Evade, Prograde 500)	**Flowable** 40.4% **Preventive:** Brown Patch - 3-6 fl. oz. at 7-10 day intervals **Curative:** Brown Patch - 6-11 fl. oz. at 7-10 day intervals Wettable Powder (WDG90) **Preventive:** Brown Patch - 1.75-3.5 oz. at 7-10 day intervals . 4 oz = 15 Tbs. **Curative:** Brown Patch - 3.5-6.5 oz at 7-10 day intervals	Recent label changes by manufacturers restrict use on commercial turf only and not to be used on home lawns.
	Chlorothalonil + Propiconazole (Concert)	1.5 to 3 fl oz at 7 to 10 days 3 to 5.5 fl oz at 14 to 21 days 5.5 to 8.5 fl oz at 14 to 28 days	
	Chlorothalonil + Propiconazole + Fludioxonil (Instrata)	2.75 to 6 fl oz at 21 to 28 days	
	Chlorothalonil + Thiophanate methyl (Consyst, Spectro)	2 to 8 oz at 7 to 21 days 2 to 5.76 at 7 to 14 days	

Disease	Pesticide	Rates (ozs./1000 ft^2)	Remarks
Brown Patch (*Rhizoctonia solani*)	Hydrogen dioxide (Zerotol)	6-25 oz	Curative control may require 2-3 consecutive applications.
	Fenarimol (Rubigan A.S. 11.6)	0.75 - 1.5 fl. oz. at 10-21 day or 14-28 day intervals respectively for Dollar Spot	
	Fludioxonil (Medallion)	0.5 to 0.9 oz. at 14-28 day intervals	Use as preventative. Begin application when conditions are favorable for fungal infection; prior to disease symptom development.
	Flutolanyl (ProStar 70WP)	**Preventive:** 2.2 oz. at 21-28 day intervals **Curative:** 4.5 oz. Repeat in 30 days.	Use of wetting agent or aerification prior to treatment may improve disease control. Do not treat more than 10,000 ft. Per acre of turfgrass
	Flutolanyl + Thiophanate methyl (Systar)	2 to 3 oz at 14 to 30 days	
	Fluoxastrobin (Disarm 480 SC Disarm G)	0.18 to 0.36 fl. oz. at 21 day intervals 2.3 to 4.6 lb at 14 to 21 days	For optimum results begin applications preventatively and continue as needed (21 day intervals). To limit the potential for development of fungicide resistance use a maximum of 2 sequential applications of a QoI fungicide followed by at least an equal number of applications of another mode of action fungicide. Preventive control of light to moderate dollar spot infections
	Iprodione (Chipco 26GT, Chipco 26019, Iprodione Pro 2SE, Raven)	2-4 fl. oz. in 2-10 gals. water. Apply every 14-21 days. 1.5 oz. = 9 Tbs 1.5-2.0 oz. At 14-21 day intervals 3-4 fl. oz at 14-28 day intervals	Not for use in residential areas
	Mancozeb + Copper Hydroxide (Junction)	2-4 oz. at 7-14 day intervals	
	Maneb, Maneb + zinc sulfate, Mancozeb (Tersan LSR, Fore, Dithane, Protect T/O, etc.)	**Preventive:** 3-4 oz. in 3-5 gals. water at 7-10 day intervals **Curative:** 6-8 oz. in 3-5 gals. water at 7-10 day intervals 3 oz. = 10 Tbs.	
	Metconazole (Tourney)	Brown Patch – 0.28 to 0.37 oz. at 14-21 day intervals	Apply when conditions are favorable for disease development. Do not use on bermudagrass.
	Myclobutanil (Eagle 40WSP)	**Preventive:** 0.6 oz. at 10-28 day intervals (3 oz. pkt/5000 ft^2)	Do not apply more than 7.2 oz./1000 ft^2 per year.
	PCNB (Defend, Engage, Penstar, Revere, Terraclor, Turfcide, Turfgo)	Brown Patch: warm season grasses - 16 oz. in 10 to 15 gal. water at 3-4 weeks cool season grasses - 3-4 oz. in 3 to 6 gal. water at 7-10 days	
	Polyoxin D (Endorse)	4 oz. in a minimum of 2 gallons at 14 day intervals	Do not irrigate for 12 hrs after application.

Disease	Pesticide	Rates (ozs./1000 ft^2)	Remarks
Brown Patch (*Rhizoctonia solani*)	Propiconazole (Banner Maxx, Banner GL, Savvi, Propiconazole Pro, Prophesy, Kestrel)	1-2 fl. oz. (Dollar Spot & Brown Patch) 14-21 day intervals for Brown Patch. As conditions become more severe, use the shorter application schedule and the higher rate Banner GL individual packets; one packet treats 11,000-22,000 ft^2	Do not mow or irrigate treated areas until grass is completely dry. Do not use on home lawns. Bermudagrass and St. Augustine grass can be sensitive to Banner. Do not exceed 2 fl. oz. per 1000 ft^2 every 30 days on any variety of Bermudagrass or St. Augustinegrass.
	Pyraclostrobin (Insignia)	0.5 - 0.9 oz. at 14-28 day intervals	
	Thiophanate methyl (Cleary's, 3336, 3336 Plus, Topsin, Fungo, Absorb TM, Cavalier, Systec 1998)	Wettable Powder (50%) 2 oz./5 gals. water Apply at 7-10 day intervals Apply at 2-4 week intervals **Flowable** 46.2 % 1-2 fl. oz. at 10-14 day intervals	
	Thiophanate methyl + Iprodione (Fluid Fungicide, Proturf)	1.1 to 2.1 at 7 to 14 days	
	Thiram (Spotrete F)	**Preventative:** 3 ¾ fl. oz. at 7-10 day intervals **Curative:** 7 ½ fl. oz. at 3-5 day intervals	For best results use spray mix the same day it is prepared. Spray right after mowing or avoid mowing 12 hrs after application.
	Triadimefon (Bayleton 25WP, Granular turf fungicide, Systemic fungicide, Fungicide VII)	**Preventive:** 1 oz./2-4 gals. water **Curative:** 2 oz./2-4 gals. water. 1 oz. = 6 Tbs. **Preventive:** 1.5 lb at 15-30 day intervals **Curative:** 3 lb at 15-30 day intervals Syst. Fung. 0.5-1 oz. At 15-30 day intervals	Apply recommended rate at 15-30 day intervals. Protective activity can be longer than 30 days depending on environmental conditions. After the application of curative rate, subsequent applications should be applied on a preventative schedule and rate.
	Trifloxystrobin (Compass)	**Preventive:** 0.1-0.2 oz. in 1-2 gals. of water per 1000 ft^2 at 14 day intervals **Curative:** 0.15-0.25 oz. in 1-2 gals. of water per 1000 ft^2	Apply when conditions are favorable for disease development. Apply 0.2 oz. and repeat on a 21 day intervals.
	Trifloxystrobin + Triadimefon (Tartan, Armada)	1 to 2 oz at 14 to 28 days 0.6 to 1.2 oz at 14 to 28 days	
	Triticonazole (Trinity, Triton)	0.5 to 2.0 fl. oz. for Brown Patch at 14-28 day intervals.	2 fl. oz. rates may be applied if needed in transition areas of the South under heavy disease pressure.
	Vinclozolin (Vorlan, Curalan, Touche) (For Dollar Spot)	2 oz. /5 gals. water 2 oz. = 8.5 tbs	Repeat application in 1-3 weeks while disease conditions prevail. Toxic to fish.

Dollar Spot. Caused by *Sclerotinia homoeocarpa*. All species of warm- and cool-season turfgrass are susceptible. Tall fescue, Kentucky bluegrass, perennial ryegrass, bentgrass, centipede, zoysiagrass and bermudagrass hybrids are particularly susceptible. The disease is promoted by dry soil conditions, extended leaf wetness and low nitrogen levels in soil. **Symptoms:** Circular straw-colored infection centers are only a few inches across, although spots may merge, resembling brown patch. Live blades may have straw-colored lesions along one edge. Lesion expands across blade, causing tip to dieback. Abundant white fungus growth evident early in the morning when dew is present may be seen during periods of severe disease development.

Disease	Pesticide	Rates (ozs./1000 ft^2)	Remarks
Dollar Spot (*Sclerotinia homoeocarpa*)	Azoxystrobin _+ propiconazole (Headway)	0.75-3 oz at 14 to 28 days intervals	
	Boscalid (Emerald)	0.13 to 0.18 oz. at 14 to 21 day intervals	*For Dollar Spot control only. Apply when conditions are favorable for disease development.
	Bacillus licheniformis (EcoGuard SB 3086)	Up to 20 oz at 3-14 days intervals	
	Bacillus subtilis Strain QST713 (Rhapsody)	2.0 to 10 fl oz. at 7-10 day intervals	Apply in sufficient water to provide thorough coverage. 2 gal /1000 ft^2 are commonly used.
	Bacillus subtilis Strain GB03 (Companion)	4.0 to 6 fl oz. 14-28 day intervals	
	Chlorothalonil (Concord DF, Concord SST, Daconil Ultrex, Daconil Weatherstik, Daconil Zn, Echo DF, Manicure, Evade, Prograde 500)	**Flowable** 40.4% **Preventive:** Dollar Spot - 3-6 fl. oz. at 7-14 day intervals **Curative:** Dollar Spot - 6-11 fl. oz. at 7-14 day intervals Wettable Powder (WDG90) **Preventive:** Dollar Spot - 1.75-3.5 oz. at 7-14 day intervals. 4 oz = 15 Tbs. **Curative:** Dollar Spot - 3.5-6.5 oz at 7-14 day intervals	Recent label changes by manufacturers restrict use on commercial turf only and not to be used on home lawns.
	Chlorothalonil + Propiconazole (Concert)	1.5 to 3 fl oz at 7 to 10 days 3 to 5.5 fl oz at 14 to 21 days 5.5 to 8.5 fl oz at 14 to 28 days	
	Chlorothalonil + Propiconazole + Fludioxonil (Instrata)	2.75 to 6 fl oz at 21 to 28 days	
	Chlorothalonil + Thiophanate methyl (Consyst, Spectro)	2 to 8 oz at 7 to 21 days 2 to 5.76 at 7 to 14 days	
	Hydrogen dioxide (Zerotol)	6-25 oz	Curative control may require 2-3 consecutive applications.
	Fenarimol (Rubigan A.S. 11.6)	0.75 - 1.5 fl. oz. at 10-21 day or 14-28 day intervals respectively for Dollar Spot	
	Fludioxonil (Medallion)	0.5 to 0.9 oz. at 14-28 day intervals	Use as preventative. Begin application when conditions are favorable for fungal infection; prior to disease symptom development.

Disease	Pesticide	Rates (ozs./1000 ft^2)	Remarks
Dollar Spot (*Sclerotinia homoeocarpa*)	Flutolanyl (ProStar 70WP)	**Preventive:** 2.2 oz. at 21-28 day intervals **Curative:** 4.5 oz. Repeat in 30 days.	Use of wetting agent or aerification prior to treatment may improve disease control. Do not treat more than 10,000 ft. Per acre of turfgrass
	Flutolanyl + Thiophanate methyl (Systar)	2 to 3 oz at 14 to 30 days	
	Fluoxastrobin (Disarm 480 SC Disarm G)	0.18 to 0.36 fl. oz. at 21 day intervals 2.3 to 4.6 lb at 14 to 21 days	To limit the potential for development of fungicide resistance use a maximum of 2 sequential applications of a QoI fungicide followed by at least an equal number of applications of another mode of action fungicide. Preventive control of light to moderate dollar spot infections
	Iprodione (Chipco 26GT, Chipco 26019, Iprodione Pro 2SE, Raven)	2-4 fl. oz. in 2-10 gals. water. Apply every 14-21 days. 1.5 oz. = 9 Tbs 1.5-2.0 oz. At 14-21 day intervals 3-4 fl. oz at 14-28 day intervals	Not for use in residential areas
	Mancozeb + Copper Hydroxide (Junction)	2-4 oz. at 7-14 day intervals	
	Maneb, Maneb + zinc sulfate, Mancozeb (Tersan LSR, Fore, Dithane, Protect T/O, etc.)	**Preventive:** 3-4 oz. in 3-5 gals. water at 7-10 day intervals **Curative:** 6-8 oz. in 3-5 gals. water at 7-10 day intervals 3 oz. = 10 Tbs.	
	Metconazole (Tourney)	Dollar Spot – 0.18 to 0.37 oz. at 14-21 day intervals	Apply when conditions are favorable for disease development. Do not use on bermudagrass.
	Myclobutanil (Eagle 40WSP)	**Preventive:** 0.6 oz. at 10-28 day intervals (3 oz. pkt/5000 ft^2)	Do not apply more than 7.2 oz./1000 ft^2 per year.
	PCNB (Defend, Engage, Penstar, Revere, Terraclor, Turfcide, Turfgo)	Dollar Spot – 7 to 10 oz. in 5 to 10 gal. water at 3 to 4 weeks	
	Polyoxin D (Endorse)	4 oz. in a minimum of 2 gallons at 14 day intervals	Do not irrigate for 12 hrs after application. *Not recommended for Dollar Spot.
	Propiconazole (Banner Maxx, Banner GL, Savvi, Propiconazole Pro, Prophesy, Kestrel)	1-2 fl. oz 2-5 gals. water at 14-28 day intervals for dollar spot . As conditions become more severe, use the shorter application schedule and the higher rate Banner GL individual packets; one packet treats 11,000-22,000 ft^2	Do not mow or irrigate treated areas until grass is completely dry. Do not use on home lawns. Bermudagrass and St. Augustine grass can be sensitive to Banner. Do not exceed 2 fl. oz. per 1000 ft^2 every 30 days on any variety of Bermudagrass or St. Augustinegrass.
	Pyraclostrobin (Insignia)	0.5 - 0.9 oz. at 14-28 day intervals	For Dollar Spot, begin applications prior to or in the early stages of disease development. Use shorter specified application interval and / or higher specified rate when prolonged favorable disease conditions exist.

Disease	Pesticide	Rates (ozs./1000 ft^2)	Remarks
Dollar Spot (*Sclerotinia homoeocarpa*)	Thiophanate methyl (Cleary's, 3336, 3336 Plus, Topsin, Fungo, Absorb TM, Cavalier, Systec 1998)	Wettable Powder (50%) 2 oz./5 gals. water Apply at 7-10 day intervals Dollar spot fairways—1 oz./5 gals water Apply at 2-4 week intervals **Flowable** 46.2 % 1-2 fl. oz. at 10-14 day intervals	
	Thiophanate methyl + Iprodione (Fluid Fungicide, Proturf)	1.1 to 2.1 at 7 to 14 days	
	Thiram (Spotrete F)	**Preventative:** 3 ¾ fl. oz. at 7-10 day intervals **Curative:** 7 ½ fl. oz. at 3-5 day intervals	For best results use spray mix the same day it is prepared. Spray right after mowing or avoid mowing 12 hrs after application.
	Triadimefon (Bayleton 25WP, Granular turf fungicide, Systemic fungicide, Fungicide VII)	**Preventive:** 1 oz./2-4 gals. water **Curative:** 2 oz./2-4 gals. water. 1 oz. = 6 Tbs. **Preventive:** 1.5 lb at 15-30 day intervals **Curative:** 3 lb at 15-30 day intervals Syst. Fung. 0.5-1 oz. At 15-30 day intervals	Apply recommended rate at 15-30 day intervals. Protective activity can be longer than 30 days depending on environmental conditions. After the application of curative rate, subsequent applications should be applied on a preventative schedule and rate.
	Trifloxystrobin (Compass)	**Preventive:** 0.1-0.2 oz. in 1-2 gals. of water per 1000 ft^2 at 14 day intervals **Curative:** 0.15-0.25 oz. in 1-2 gals. of water per 1000 ft^2	Apply when conditions are favorable for disease development. Apply 0.2 oz. and repeat on a 21 day intervals. During periods of Dollar Spot pressure, mix Compass with fungicides labeled for Dollar Spot.
	Trifloxystrobin + Triadimefon (Tartan, Armada)	1 to 2 oz at 14 to 28 days 0.6 to 1.2 oz at 14 to 28 days	
	Triticonazole (Trinity, Triton)	0.5 to 1.0 fl. oz. for Dollar Spot at 14-28 day intervals.	2 fl. oz. rates may be applied if needed in transition areas of the South under heavy disease pressure.
	Vinclozolin (Vorlan, Curalan, Touche) (For Dollar Spot)	2 oz. /5 gals. water 2 oz. = 8.5 tbs	Repeat application in 1-3 weeks while disease conditions prevail. Toxic to fish.

Pythium Blight. Caused by *Pythium* spp. Annual bluegrass, tall fescue, perennial ryegrass and varieties of bentgrass, bermudagrass, centipede, zoysiagrass and St. Augustinegrass are susceptible. The disease is promoted by excessive soil moisture caused by over irrigation or heavy rain showers. Some Pythium species favor temperatures between 32 degrees F and 50 degrees F while others thrive in temperatures between 70 degrees F and 90 degrees F. **Symptoms:** Small, irregular spots may enlarge and appear dark and water-soaked in early stages. White, cottony mycelia may be evident. Turfgrass in affected spots dies rapidly, collapses, and appears oily and matted. Gray to white fungal growth may be evident early in the morning on leaves of some turfgrass species.

Disease	Pesticide	Rates (ozs./1000 ft^2)	Remarks
Pythium Blight, Pythium Root Rots, Pythium Root Dysfunction	Azoxystrobin (Heritage 50WG, TL, G)	0.4 oz. on 10-14 day intervals 2 to 4 lb at 10-14 days intervals	
	Azoxystrobin _+ propiconazole (Headway)	3 oz at 10 to 14 days intervals	
	Bacillus subtilis Strain GB03 (Companion)	4.0 to 6 fl oz. 14-28 day intervals	
	Chloroneb (Termec SP, Terraneb, Proturf fungicide)	4 oz. in 3-5 gals. water 4 oz. = 12.5 Tbs.	
	Cyazofamid (Segway)	0.45-0.9 fl. oz. at 14-21 day intervals	Apply as a preventative treatment at 0.45 to 0.9 fl. oz. in 2 to 4 gals. of water. On established turf apply as a preventative treatment when conditions are favorable for disease development. During periods of prolonged favorable conditions use 0.45 fl. oz. on a 14 day interval, using another fungicide having a different mode of action between applications of Segway. For newly seeded areas use 0.45 fl. oz. in 2-4 gals. water immediately after seeding.
	Etridiazole (Koban 30WP, Terrazole)	**Established Turf:** 2-4.5 oz. in 5 gals. water **Newly Seeded Areas:** 7-9 oz. in 5 gals. water. 4 oz. = 9.5 Tbs. Terrazole=2-4.5 oz. At 10-14 day intervals	Retreat in 5-10 days depending on weather conditions. Can cause phytotoxicity on cool season turfs in hot weather at low carrier volumes.
	Fosetyl AL (Alliette 80WP, Chipco Signature, Prodigy Signature, Autograph)	4-8 oz. in 1-5 gal. water per 1000 ft^2 at 14-21 day intervals. Begin preventive applications when conditions first favor disease and repeat as recommended 4-8 oz 14-21 day intervals	Do not mow and/or water treated areas until foliage is completely dry
	Fluoxastrobin (Disarm 480 SC)	0.18 to 0.36 fl. oz. at 14 day intervals	Begin applications when conditions are favorable for disease development, prior to disease development. When conditions are conducive for heavy Pythium infections use Disarm in combination with another product labeled for Pythium control.

Disease	Pesticide	Rates (ozs./1000 ft^2)	Remarks
Pythium Blight, Pythium Root Rots, Pythium Root Dysfunction	Mefenoxam (Subdue, Subdue Maxx)	**Established Turf:** 2X WSP: 5-25 oz. Maxx: 0.5-1 fl. oz. in 1-5 gals of water **Newly Seeded Areas:** 2X WSP: 0.11-0.56 oz. in 1-5 gals of water Maxx: 0.5-1 fl. oz. in 1-5 gals of water	Retreat at 10-14 day intervals depending on disease pressure and weather conditions. Apply immediately after seeding and irrigate with ¼ to ½" water. Repeat application at 7-14 day intervals if conditions remain favorable for disease.
	Mancozeb + Copper Hydroxide (Junction)	2-4 oz. At 5 day intervals	
	Phosphorous acid (Alude)	5 to 10 fl. oz. at 7-14 day intervals	Apply recommended quantity of product in 1 to 5 gals. of water. Do not irrigate or mow treated areas until spray has completely dried.
	Phosphate (Magellan, Vital)	4.1 fl. oz. at 14 days 8.2 fl. oz. at 21 days	Do not irrigate or mow treated areas until spray has completely dried. Begin preventative applications when conditions first favor disease.
	Propamocarb (Banol)	**Preventative:** 1.25-2 fl. oz. in 2-5 gals. water **Curative:** 3-4 fl. oz. in 2-5 gals. water	**Established Turf:** Apply as a preventative treatment during periods of high temperature and humidity. **Overseeded Areas:** Apply after germination. Repeat at 7-21 day intervals if favorable disease conditions persist.
	Propamocarb + Fluopicolide (Stellar)	1.2 fl. oz.	The maximum Stellar application rate is 2.4 oz. per year per 1000 ft^2. **Overseeded Turf:** Apply after seed germination to prevent Pythium damping off. **Established Turf:** Apply when conditions are favorable for disease development.
	Pyraclostrobin (Insignia)	0.5 to 0.9 oz. at 14-28 day intervals	**Use as preventative.** Begin application when conditions are favorable for fungal infection; prior to disease symptom development.

Helminthosporium Leaf Spot. Caused by *Drechslera* spp; Bipolaris spp; (formerly *Helminthosporium* spp). Perennial ryegrass, tall fescue and some varieties of bentgrass, bermudagrass, zoysiagrass and centipede are susceptible. The conditions that promote the disease are low potassium levels, extended leaf wetness and/or high nitrogen levels in soil. *Drechslera* is favored by cool wet weather whereas Bipolaris is active during warm weather of midsummer. Leaf spot occurs in areas that experience more than 10 hours a day of foliar wetness for several consecutive days. Disease is also favored by high amounts of nitrogen, a low mowing height and drought stress. **Symptoms:** Small, dark spots or streaks on grass blades and sheaths. Leaf spots are more numerous near the collar area of leaf blade. Severely affected turfgrass may become brown and thin.

Disease	Pesticide	Rates (ozs./1000 ft^2)	Remarks
Helminthosporium	Azoxystrobin (Heritage 50WG, TL, G)	0.2-0.4 oz. Apply on a 14-28 day intervals 2 to 4 lb at 14-28 days intervals	
	Azoxystrobin _+ propiconazole (Headway)	0.75-3 oz at 14 to 28 days intervals	
	Bacillus licheniformis (EcoGuard SB 3086)	Up to 20 oz at 3-14 days intervals	
	Bacillus subtilis Strain QST713 (Rhapsody)	2.0 to 10 fl. oz. at 7-10 day intervals	Apply in sufficient water to provide thorough coverage. 2 gal /1000 ft^2 are commonly used.
	Bacillus subtilis Strain GB03 (Companion)	4.0 to 6 fl oz. 14-28 day intervals	
	Chlorothalonil (Concord DF, Concord SST, Daconil Ultrex, Daconil Weatherstik, Daconil Zn, Echo DF, Manicure, Evade, Prograde 500)	Flowable **Preventive:** 3-6 fl. oz. at 7-10 day intervals **Curative:** 6-11 fl. oz. at 7-10 day intervals Wettable Powder (WDG90) **Preventive:** 1.75-3.5 oz. at 7-10 day intervals **Curative:** 3.5-6.5 oz. at 7-10 day intervals	Recent label changes by manufacturers restrict use on commercial turf only and not to be used on home lawns.
	Chlorothalonil + Propiconazole (Concert)	3 to 5.5 fl oz at 14 to 21 days 5.5 to 8.5 fl oz at 14 to 28 days	
	Chlorothalonil + Propiconazole + Fludioxonil (Instrata)	2.75 to 6 fl oz at 10 to 21 days	
	Chlorothalonil + Thiophanate methyl (Consyst, Spectro)	2 to 8 oz at 7 to 21 days 2 to 5.76 at 7 to 14 days	
	Fludioxonil (Medallion)	0.2 to 0.5 oz. at 14 to 21 day intervals	Apply when conditions are favorable for disease development.
	Fluoxastrobin (Disarm 480 SC, G)	0.18 to 0.36 fl. oz. at 14-28 day intervals 2.3 to 4.6 lb at 14 to 28 days	Begin applications when conditions are favorable for disease development, prior to disease development.
	Flutolanyl + Thiophanate methyl (Systar)	2 to 3 oz at 14 days	
	Hydrogen dioxide (Zerotol)	6-25 oz	Curative control may require 2-3 consecutive applications. Use on 5-10 gal per 1000 sq ft

Disease	Pesticide	Rates (ozs./1000 ft^2)	Remarks
Helminthosporium	Iprodione (Chipco 26GT, Chipco 26019, Iprodione Pro 2SE, Fungicide X, Raven)	2-4 fl. oz. in 2-10 gals. water Apply every 14-21 days. 2 oz. = 12 Tbs. 1.5-2.0 oz. at 14-21 day intervals 3-4 fl. oz. at 14-28 day intervals	Not for use in residential areas.
	Iprodione + Thiphanate methyl (26/36)	2 to 4 oz at 14 to 21 days	
	Mancozeb + Copper Hydroxide (Junction)	2-4 oz. at 5 day intervals	
	Maneb, Maneb + zinc sulfate & Mancozeb (Fore, Protect T/O)		
	Myclobutanil (Eagle WSP 40, Golden Eagle)	**Preventive:** 0.6 oz. at 14 day intervals (3 oz. pkt./5000 ft^2)	Do not graze treated areas or feed clippings to livestock
	Metconazole (Tourney)	0.28 to 0.37 oz. at 14-21 day intervals	Apply when conditions are favorable for disease development. Do not use on Bermudagrass.
	PCNB (Defend, Engage, Penstar, Revere, Terraclor, Turfcide, Turfgo)	7-10 oz. in 5 to 10 gal. water at 3-4 weeks.	
	Polyoxin D (Endorse)	4 oz. in a minimum of 2 gallons at 14 day intervals	Do not irrigate for 12 hrs after application.
	Propiconazole (Banner Maxx, Banner GL, Savvi, Propiconazole Pro, Prophesy, Kestrel)	1-2 fl. oz. 14-28 Banner GL individual packets; one packet treats 11,000-22,000 ft^2	If anthracnose is present use 2 oz. rate in combination with Daconil or Chipco 26GT. Do not mow or irrigate treated areas until grass is completely dry. Do not use on home lawns. Bermudagrass and St. Augustinegrass can be sensitive to Banner. Do not exceed 2 fl. oz./1000 ft^2 every 30 days on any variety of Bermudagrass or St. Augustine grass. On Bentgrass, do not exceed 1 oz. /1000 ft^2 or apply at less than 21day intervals when temperatures exceed 80°F.
	Pyraclostrobin (Insignia)	0.5 to 0.9 oz. at 14-28 day intervals	**Use as preventative.** Begin application when conditions are favorable for fungal infection; prior to disease symptom development.
	Thiophanate Methyl (Cleary's, 3336, 3336 Plus, Topsin, Fungo, Absorb TM, Cavalier, Systec 1998)	**Preventive:** 1 oz. /5 gal. water (Anthracnose). Apply 10-14 days as needed **Curative:** Apply 2 oz./5 gal. water	
	Thiophanate methyl + Iprodione (Fluid Fungicide, Proturf)	1.1 to 2.1 at 7 to 14 days	

Disease	Pesticide	Rates (ozs./1000 ft^2)	Remarks
Helminthosporium	Thiram (Spotrete F)	**Preventative:** 3 ¾ fl. oz. at 7-10 day intervals **Curative:** 7 ½ fl. oz. at 3-5 day intervals	For best results use spray mix the same day it is prepared. Spray right after mowing or avoid mowing 12 hrs after application.
	Trifloxystrobin (Compass)	**Preventive:** Apply 0.1-0.15 oz. at 14 day intervals **Curative:** Leaf spot - 0.15-0.25 oz. in 1-2 gals. water at 21-28 day intervals	Apply when conditions are favorable for disease.
	Trifloxystrobin + Triadimefon (Tartan, Armada)	1 to 2 oz at 14 to 28 days 0.6 to 1.2 oz at 14 to 28 days	
	Triticonazole (Trinity, Triton)	0.5 to 1.0 fl. oz. at 14-28 day intervals	
	Vinclozolin (Vorlan, Curalan, Touche)	1-2 oz. (*Helminthosporium*) at 14-28 day intervals	

Curvularia Diseases. Caused by *Curvularia* spp. Perennial ryegrass, tall fescue, bentgrass, bermudagrass, zoysiagrass and centipede are susceptible to the disease. The conditions that promote the disease are similar to *Helminthosporium* leaf spot. Usually weakly pathogenic unless turfgrass is predisposed to high temperature stress. **Symptoms:** Vary with type of grass. Fescue C indefinite yellow/green dappled pattern extending down from leaf tip. Affected area turns brown, then gray, and then dies. Reddish brown margin may or may not be present. In Bentgrass, affected parts of blades are tan instead of brown or gray.

Disease	Pesticide	Rates (ozs./1000 ft^2)	Remarks
Curvularia, Leaf Spots	Azoxystrobin (Heritage 50WG, TL, G)	0.2-0.4 oz. Apply on a 14-28 day intervals 2 to 4 lb at 14-28 days intervals	
	Azoxystrobin _+ propiconazole (Headway)	0.75-3 oz at 14 to 28 days intervals	
	Bacillus licheniformis (EcoGuard SB 3086)	Up to 20 oz at 3-14 days intervals	
	Bacillus subtilis Strain QST713 (Rhapsody)	2.0 to 10 fl. oz. at 7-10 day intervals	Apply in sufficient water to provide thorough coverage. 2 gal /1000 ft2 are commonly used.
	Bacillus subtilis Strain GB03 (Companion)	4.0 to 6 fl oz. 14-28 day intervals	
	Chlorothalonil (Concord DF, Concord SST, Daconil Ultrex, Daconil Weatherstik, Daconil Zn, Echo DF, Manicure, Evade, Prograde 500)	Flowable **Preventive:** 3-6 fl. oz. at 7-10 day intervals **Curative:** 6-11 fl. oz. at 7-10 day intervals Wettable Powder (WDG90) **Preventive:** 1.75-3.5 oz. at 7-10 day intervals **Curative:** 3.5-6.5 oz. at 7-10 day intervals	Recent label changes by manufacturers restrict use on commercial turf only and not to be used on home lawns.
	Chlorothalonil + Propiconazole (Concert)	3 to 5.5 fl oz at 14 to 21 days 5.5 to 8.5 fl oz at 14 to 28 days	

Disease	Pesticide	Rates (ozs./1000 ft^2)	Remarks
Curvularia, Leaf Spots	Chlorothalonil + Propiconazole + Fludioxonil (Instrata)	2.75 to 6 fl oz at 10 to 21 days	
	Chlorothalonil + Thiophanate methyl (Consyst, Spectro)	2 to 8 oz at 7 to 21 days 2 to 5.76 at 7 to 14 days	
	Fludioxonil (Medallion)	0.2 to 0.5 oz. at 14 to 21 day intervals	Apply when conditions are favorable for disease development.
	Fluoxastrobin (Disarm 480 SC, G)	0.18 to 0.36 fl. oz. at 14-28 day intervals 2.3 to 4.6 lb at 14 to 28 days	Begin applications when conditions are favorable for disease development, prior to disease development.
	Flutolanyl + Thiophanate methyl (Systar)	2 to 3 oz at 14 days	
	Hydrogen dioxide (Zerotol)	6-25 oz	Curative control may require 2-3 consecutive applications. Use on 5-10 gal per 1000 sq ft
	Iprodione (Chipco 26GT, Chipco 26019, Iprodione Pro 2SE, Fungicide X, Raven)	2-4 fl. oz. in 2-10 gals. water Apply every 14-21 days. 2 oz. = 12 Tbs. 1.5-2.0 oz. at 14-21 day intervals 3-4 fl. oz. at 14-28 day intervals	Not for use in residential areas.
	Iprodione + Thiphanate methyl (26/36)	2 to 4 oz at 14 to 21 days	
	Mancozeb + Copper Hydroxide (Junction)	2-4 oz. at 5 day intervals	
	Maneb, Maneb + zinc sulfate & Mancozeb (Fore, Protect T/O)		
	Myclobutanil (Eagle WSP 40, Golden Eagle)	**Preventive:** 0.6 oz. at 14 day intervals (3 oz. pkt./5000 ft^2)	Do not graze treated areas or feed clippings to livestock
	Metconazole (Tourney)	0.28 to 0.37 oz. at 14-21 day intervals	Apply when conditions are favorable for disease development. Do not use on Bermudagrass.
	PCNB (Defend, Engage, Penstar, Revere, Terraclor, Turfcide, Turfgo)	7-10 oz. in 5 to 10 gal. water at 3-4 weeks.	
	Polyoxin D (Endorse)	4 oz. in a minimum of 2 gallons at 14 day intervals	Do not irrigate for 12 hrs after application.

Disease	Pesticide	Rates (ozs./1000 ft^2)	Remarks
Curvularia, Leaf Spots	Propiconazole (Banner Maxx, Banner GL, Savvi, Propiconazole Pro, Prophesy, Kestrel)	1-2 fl. oz. 14-28 Banner GL individual packets; one packet treats 11,000-22,000 ft^2	If anthracnose is present use 2 oz. rate in combination with Daconil or Chipco 26GT. Do not mow or irrigate treated areas until grass is completely dry. Do not use on home lawns. Bermudagrass and St. Augustinegrass can be sensitive to Banner. Do not exceed 2 fl. oz./1000 ft2 every 30 days on any variety of Bermudagrass or St. Augustine grass. On Bentgrass, do not exceed 1 oz. /1000 ft2 or apply at less than 21day intervals when temperatures exceed 80°F.
	Pyraclostrobin (Insignia)	0.5 to 0.9 oz. at 14-28 day intervals	Use as preventative. Begin application when conditions are favorable for fungal infection; prior to disease symptom development.
	Thiophanate Methyl (Cleary's, 3336, 3336 Plus, Topsin, Fungo, Absorb TM, Cavalier, Systec 1998)	**Preventive:** 1 oz. /5 gal. water (Anthracnose). Apply 10-14 days as needed **Curative:** Apply 2 oz./5 gal. water	
	Thiophanate methyl + Iprodione (Fluid Fungicide, Proturf)	1.1 to 2.1 at 7 to 14 days	
	Thiram (Spotrete F)	**Preventative:** 3 ¾ fl. oz. at 7-10 day intervals **Curative:** 7 ½ fl. oz. at 3-5 day intervals	For best results use spray mix the same day it is prepared. Spray right after mowing or avoid mowing 12 hrs after application.
	Trifloxystrobin (Compass)	**Preventive:** Apply 0.1-0.15 oz. at 14 day intervals **Curative:** Leaf spot - 0.15-0.25 oz. in 1-2 gals. water at 21-28 day intervals Rust - 0.2-0.25 oz. in 1-2 gals. water at 21 day intervals **Preventive:** Anthracnose - 0.15-0.2 oz. at 14 day intervals in 1-2 gals. water **Curative:** 0.25 oz. at 21 day intervals in 1-2 gals. Water	Apply when conditions are favorable for disease.
	Trifloxystrobin + Triadimefon (Tartan, Armada)	1 to 2 oz at 14 to 28 days 0.6 to 1.2 oz at 14 to 28 days	
	Triticonazole (Trinity, Triton)	0.5 to 1.0 fl. oz. at 14-28 day intervals	
	Vinclozolin (Vorlan, Curalan, Touche)	1-2 oz. (*Helminthosporium*) at 14-28 day intervals	

Gray Leaf Spot. Caused by *Pyricularia grisea*. Gray leaf spot affects a wide variety of hosts. However it is of primary importance on St. Augustinegrass and perennial ryegrass. Bermuda, centipede, bentgrass and various species of fescue may also be affected, albeit to a lesser degree. Conditions promoting disease include: high humidity, warm temperatures, and high nitrogen levels. **Symptoms:** On St. Augustinegrass, gray leaf spot first appears as small, brown spots on the leaves and stems. The spots quickly enlarge to approximately 3 inch in length and become bluish-gray in color and oval or elongated in shape. The mature lesions are tan to gray in color and have depressed centers with irregular margins that are purple to brown in color. A yellow border on the lesions can also occur. Severely affected blades wither and turn brown.

Disease	Pesticide	Rates (ozs./1000 ft^2)	Remarks
Gray Leaf Spot (*Pyricularia*)	Azoxystrobin (Heritage 50WG, TL, G)	0.2 to 0.4 oz. at 14 to 28 day intervals 2 to 4 lb at 14-28 days intervals	
	Azoxystrobin _+ propiconazole (Headway)	1.5 to 3 oz at 14 to 28 days intervals	
	Chlorothalonil (Daconil 2787, Concord DF, Concord SST, Daconil Ultrex, Daconil Weatherstik, Daconil Zn, Echo DF, Manicure)	Flowable **Preventive:** 3-6 fl. oz. at 7-10 day intervals **Curative:** 6-11 fl. oz. at 7-10 day intervals Wettable Powder (WDG90) **Preventive:** 1.75-3.5 oz. at 7-10 day intervals **Curative:** 3.5-6.5 oz. at 7-10 day intervals	
	Chlorothalonil + Propiconazole (Concert)	3 to 5.5 fl oz at 7 to 14 days 5.5 to 8.5 fl oz at 14 to 21 days	
	Chlorothalonil + Propiconazole + Fludioxonil (Instrata)	2.75 to 6 fl oz at 10 to 14 days	
	Chlorothalonil + Thiophanate methyl (Consyst, Spectro)	2 to 8 oz at 7 to 14 days 2 to 5.76	
	Fluoxastrobin (Disarm 480 SC, G)	0.18 to 0.36 fl. oz. at 14--28 day intervals 2.3 to 4.6 lb at 14 to 28 days	
	Flutolanyl + Thiophanate methyl (Systar)	2 to 3 oz at 14 days	
	Polyoxin D (Endorse)	4 oz. in a minimum of 2 gallons at 14 day intervals	
	Metconazole (Tourney)	0.37 oz. at 14-21 day intervals	
	Propiconazole (Banner Maxx, Banner GL, Savvi, Propiconazole Pro, Prophesy, Kestrel)	2 fl. oz. at 14 day intervals Banner GL individual packets; one packet treats 11,000-22,000 ft^2	
	Pyraclostrobin (Insignia)	0.5 to 0.9 oz. at 14-28 day intervals	

Disease	Pesticide	Rates (ozs./1000 ft^2)	Remarks
Gray Leaf Spot (*Pyricularia*)	Thiophanate Methyl (Cleary's, 3336, 3336 Plus, Topsin, Fungo, Absorb TM, Cavalier, Systec 1998)	**Preventive:** 1 oz. /5 gal. water. Apply 10-14 days as needed **Curative:** Apply 2 oz./5 gal. water	
	Triadimefon (Bayleton 25WP, Granular turf fungicide, Systemic fungicide, Fungicide VII)	Preventive. 1.5 lb at 15-30 day intervals Curative. 3 lb at 15-30 day intervals Syst. Fung. 0.5-1 oz. At 15-30 day intervals	
	Trifloxystrobin (Compass)	Apply 0.15-0.2 oz. in 1-2 gals. water at 14 day intervals or 0.25 oz. in 1-2 gals. water at 21 day intervals.	
	Trifloxystrobin + Triadimefon (Tartan, Armada)	1 to 2 oz at 14 to 28 days 0.6 to 1.2 oz at 14 to 28 days	
	Zineb	4 oz. in 5-10 gals. water 4 oz. = 13 Tbs.	

Fairy Ring. Caused by few species of mushroom and puff ball-producing fungi (Basidiomycetes). The disease is particularly damaging on centipede and St. Augustinegrass in south and coastal Georgia. The conditions promoting disease are: Presence of fungus and moist, warm weather. **Symptoms:** Circular or semi-circular band of darker-than-usual green grass. Grass inside ring usually is not as vigorous and may be declining. Grass may be dead inside young rings; a band of dead grass with greener grass in the middle may be seen in older rings. During rainy, moist conditions, a ring of mushrooms may appear.

Disease	Pesticide	Rates (ozs./1000 ft^2)	Remarks
Fairy Ring	Azoxystrobin (Heritage 50WG, Heritage TL, Heritage G)	0.4 oz. applied at 28 day intervals 2 to 4 lb at 14-28 days intervals	
	Azoxystrobin _+ propiconazole (Headway)	3 oz at 28 days intervals	
	Hydrogen dioxide (Zerotol)	2- to 12 fl oz	Curative control may require 2-3 consecutive applications. Drench the soil to saturate root system. Use on 5-10 gal per 1000 sq ft
	Flutolanyl (ProStar 70WP)	**Preventive:** 2.2 oz. at 21-28 day intervals **Curative:** 4.5 oz. at first sign of activity Repeat in 30 days. Apply in 10 to 50 gals. water/1000 ft^2.	Use of wetting agent or aerification prior to treatment may improve disease control. Do not treat more than 10,000 ft. per acre of turfgrass.
	Flutolanyl + Thiophanate methyl (Systar)	3 to 6.12 oz at 21 to 28 days	
	Fluoxastrobin (Disarm 480 SC, Disarm G)	0.36 fl. oz. at 28 day intervals	

Disease	Pesticide	Rates (ozs./1000 ft^2)	Remarks
Fairy Ring	Metconazole (Tourney)	0.37 oz.	Apply in 4 gal water/1000 ft2. Symptoms may take several weeks to disappear following application. Do not use on bermudagrass.
	Pyraclostrobin (Insignia)	0.5 to 0.9 oz. at 14-28 day intervals	Use as preventative. Begin application when conditions are favorable for fungal infection; prior to disease symptom development.
	Polyoxin D (Endorse)	4 oz. in a minimum of 2 gallons at 7 day intervals	Make 2-3 applications. Use a penetrating wetting agent. Water in immediately after treatment.

Take-All Patch, Take-All Root Rot, Bermudagrass Decline. Caused by *Gaumannomyces graminis*. Bentgrass, St. Augustinegrass, bermudagrass and centipedegrass are susceptible. Bluegrass and fescues are rarely affected in Georgia. Take-all patch typically occurs in wet soils and in areas with soil pH 6.5 or above. This disease is more severe on less fertile and sandy soils. **Symptoms:** Wilted circular patches that are brown or bronze-colored and measure up to several feet in diameter. Infected plants have dark-brown roots.

Disease	Pesticide	Rates (ozs./1000 ft^2)	Remarks
Take all patch/root rot (*Gaeumannomyces graminis*) Bermuda Decline (see fungicide labels for specific *Gaeumannomyces* species/diseases)	Azoxystrobin (Heritage 50 WG, G)	0.4 oz. at 28 day intervals 2 to 4 lb at 28 days intervals	Make 1 or 2 applications in fall or when conditions are favorable for disease development.
	Azoxystrobin _+ propiconazole (Headway)	3 oz at 14 to 28 days intervals	
	Fenarimol (Rubigan A.S.)	4 oz. in September or 6 oz. in October or November and irrigated with ½ to 1" of water	
	Fluoxastrobin (Disarm 480 SC, G)	0.36 fl. oz. at 14 day intervals	Apply 1-2 applications approximately one month before turfgrass dormancy. ¼ to ½" of direct irrigation is recommended after application.
	Myclobutanil (Eagle 40WSP)	1.2 to 2.4 oz. at 28 day intervals (spring and fall)	
	Propiconazole (Banner Maxx, Banner GL, Savvi, Propiconazole Pro, Prophesy, Kestrel)	4 oz. at 30 day intervals. Banner GL individual packets; one packet treats 11,000-22,000 ft^2	Make 1-3 applications. For one application apply in September or October. For multiple applications, begin sprays in August.
	Pyraclostrobin (Insignia)	0.5 to 0.9 oz. at 14-28 day intervals	Use as preventative. Begin application when conditions are favorable for fungal infection; prior to disease symptom development.
	Thiophanate Methyl (Cleary's 3336, 3336 F, 3336 Plus, Topsin, Fungo, Absorb TM, Cavalier, Systec 1998)	4 to 6 oz at 14 day intervals	

Disease	Pesticide	Rates (ozs./1000 ft^2)	Remarks
Take all patch/root rot (*Gaeumannomyces graminis*) Bermuda Decline (see fungicide labels for specific *Gaeumannomyces* species/diseases)	Triadimefon (Bayleton 25WP, Granular turf fungicide, Systemic fungicide)	**Preventative:** 2 oz. start sprays 2 to 4 weeks before symptoms reappear. Re-apply every 3-4 weeks **Curative:** 4 oz. make 1-2 sprays on a 2-3 week interval followed by the preventative rate at 3-4 week interval Apply 2 to 4 gallons of spray volume per 1,000 ft2. Thoroughly water after each application.	
	Triticonazole (Trinity, Triton)	0.5 to 1.0 fl. oz. at 14-28 day intervals.	Make 1 or 2 fall applications (September and October) and 1 or 2 spring applications (April and May) depending on local conditions.

Rust. Caused by *Puccinia* spp., *Uromyces* spp. Susceptible turfgrass include Kentucky bluegrass, ryegrass, bentgrass, zoysiagrass, bermudagrass and fescue. Rusts occur in early spring through mid-summer. Rusts favor moist, low-light areas. Depending on the species, rusts favor temperatures between 65 degrees F and 85 degrees F. Severe rust infections occur on slow-growing turfgrass maintained under conditions of low nitrogen and/or drought stress. **Symptoms:** Light-yellow flecks on the leaf blades and sheaths. The flecks enlarge, elongate, and turn yellow in color. The infected areas expend above the epidermis and then rupture, releasing spores that are yellowish-orange to reddish-brown in color.

Disease	Pesticide	Rates (ozs./1000 ft^2)	Remarks
Rusts	Azoxystrobin (Heritage 50WG, TL, G)	0.2-0.4 oz. Apply on a 14-28 day intervals 2 to 4 lb at 14-28 days intervals	
	Azoxystrobin _+ propiconazole (Headway)	0.75-3 oz at 14 to 28 days intervals	
	Bacillus licheniformis (EcoGuard SB 3086)	Up to 20 oz at 3-14 days intervals	
	Bacillus subtilis Strain QST713 (Rhapsody)	2.0 to 10 fl. oz. at 7-10 day intervals	Apply in sufficient water to provide thorough coverage. 2 gal /1000 ft2 are commonly used.
	Bacillus subtilis Strain GB03 (Companion)	4.0 to 6 fl oz. 14-28 day intervals	
	Chlorothalonil (Concord DF, Concord SST, Daconil Ultrex, Daconil Weatherstik, Daconil Zn, Echo DF, Manicure, Evade, Prograde 500)	Flowable **Preventive:** 3-6 fl. oz. at 7-10 day intervals **Curative:** 6-11 fl. oz. at 7-10 day intervals Wettable Powder (WDG90) **Preventive:** 1.75-3.5 oz. at 7-10 day intervals **Curative:** 3.5-6.5 oz. at 7-10 day intervals	Recent label changes by manufacturers restrict use on commercial turf only and not to be used on home lawns.
	Chlorothalonil + Propiconazole (Concert)	3 to 5.5 fl oz at 14 to 21 days 5.5 to 8.5 fl oz at 14 to 28 days	
	Chlorothalonil + Propiconazole + Fludioxonil (Instrata)	2.75 to 6 fl oz at 10 to 21 days	

Disease	Pesticide	Rates (ozs./1000 ft^2)	Remarks
Rusts	Chlorothalonil + Thiophanate methyl (Consyst, Spectro)	2 to 8 oz at 7 to 21 days 2 to 5.76 at 7 to 14 days	
	Fludioxonil (Medallion)	0.2 to 0.5 oz. at 14 to 21 day intervals	Apply when conditions are favorable for disease development.
	Fluoxastrobin (Disarm 480 SC, G)	0.18 to 0.36 fl. oz. at 14-28 day intervals 2.3 to 4.6 lb at 14 to 28 days	Begin applications when conditions are favorable for disease development, prior to disease development.
	Flutolanyl + Thiophanate methyl (Systar)	2 to 3 oz at 14 days	
	Hydrogen dioxide (Zerotol)	6-25 oz	Curative control may require 2-3 consecutive applications. Use on 5-10 gal per 1000 sq ft
	Iprodione (Chipco 26GT, Chipco 26019, Iprodione Pro 2SE, F ungicide X, Raven)	2-4 fl. oz. in 2-10 gals. water Apply every 14-21 days. 2 oz. = 12 Tbs. 1.5-2.0 oz. at 14-21 day intervals 3-4 fl. oz. at 14-28 day intervals	Not for use in residential areas.
	Iprodione + Thiphanate methyl (26/36)	2 to 4 oz at 14 to 21 days	
	Mancozeb + Copper Hydroxide (Junction)	2-4 oz. at 5 day intervals	
	Maneb, Maneb + zinc sulfate & Mancozeb (Fore, Protect T/O)		
	Myclobutanil (Eagle WSP 40, Golden Eagle)	**Preventive:** 0.6 oz. at 14 day intervals (3 oz. pkt./5000 ft^2)	Do not graze treated areas or feed clippings to livestock
	Metconazole (Tourney)	0.28 to 0.37 oz. at 14-21 day intervals	Apply when conditions are favorable for disease development. Do not use on Bermudagrass.
	PCNB (Defend, Engage, Penstar, Revere, Terraclor, Turfcide, Turfgo)	7-10 oz. in 5 to 10 gal. water at 3-4 weeks.	
	Polyoxin D (Endorse)	4 oz. in a minimum of 2 gallons at 14 day intervals	Do not irrigate for 12 hrs after application.
	Propiconazole (Banner Maxx, Banner GL, Savvi, Propiconazole Pro, Prophesy, Kestrel)	1-2 fl. oz. 14-28 Banner GL individual packets; one packet treats 11,000-22,000 ft^2	If anthracnose is present use 2 oz. rate in combination with Daconil or Chipco 26GT. Do not mow or irrigate treated areas until grass is completely dry. Do not use on home lawns. Bermudagrass and St. Augustinegrass can be sensitive to Banner. Do not exceed 2 fl. oz./1000 ft2 every 30 days on any variety of Bermudagrass or St. Augustine grass. On Bentgrass, do not exceed 1 oz. /1000 ft2 or apply at less than 21day intervals when temperatures exceed 80°F.

Disease	Pesticide	Rates (ozs./1000 ft^2)	Remarks
Rusts	Pyraclostrobin (Insignia)	0.5 to 0.9 oz. at 14-28 day intervals	Use as preventative. Begin application when conditions are favorable for fungal infection; prior to disease symptom development.
	Thiophanate Methyl (Cleary's, 3336, 3336 Plus, Topsin, Fungo, Absorb TM, Cavalier, S ystec 1998)	**Preventive:** 1 oz. /5 gal. water (Anthracnose). Apply 10-14 days as needed **Curative:** Apply 2 oz./5 gal. water	
	Thiophanate methyl + Iprodione (Fluid Fungicide, Proturf)	1.1 to 2.1 at 7 to 14 days	
	Thiram (Spotrete F)	**Preventative:** 3 ¾ fl. oz. at 7-10 day intervals **Curative:** 7 ½ fl. oz. at 3-5 day intervals	For best results use spray mix the same day it is prepared. Spray right after mowing or avoid mowing 12 hrs after application.
	Trifloxystrobin (Compass)	**Preventive:** Apply 0.1-0.15 oz. at 14 day intervals **Curative:** Leaf spot - 0.15-0.25 oz. in 1-2 gals. water at 21-28 day intervals Rust - 0.2-0.25 oz. in 1-2 gals. water at 21 day intervals **Preventive:** Anthracnose - 0.15-0.2 oz. at 14 day intervals in 1-2 gals. water **Curative:** 0.25 oz. at 21 day intervals in 1-2 gals. Water	Apply when conditions are favorable for disease.
	Trifloxystrobin + Triadimefon (Tartan, Armada)	1 to 2 oz at 14 to 28 days 0.6 to 1.2 oz at 14 to 28 days	
	Triticonazole (Trinity, Triton)	0.5 to 1.0 fl. oz. at 14-28 day intervals	
	Vinclozolin (Vorlan, Curalan, Touche)	1-2 oz. (*Helminthosporium*) at 14-28 day intervals	

Turfgrass Fungicide Formulations

Fungicides are available in many different formulations. Below are the common formulations and their standard abbreviations.

Wettable Powders (WP): Most fungicide are formulated as wettable powders. The active ingredient is normally combined with a solid material (clay or talc) and is suspended in water with the aid of an emulsifier. Many of these suspensions settle out quickly, so an agitator is needed in the spray tank to keep the particles in suspension. Even though plant injury is rarely a problem with wettable powders, there can be excessive wear on spray nozzles with prolonged use of these formulations.
Examples: Bayleton, Prostar, Tersan, Alliette etc.

Water Soluble Packets (SP or WSP): Some WP fungicides are now available in water soluble pouches. These pouches contain enough product for a single application. Pouches are placed in the mixing tank to release the fungicide; this reduces the exposure of mixer and loader personnel to dust from the fungicide. Fungicides available in this form do not require continuous agitation.
Example: Eagle

Granules (G): Small pellets of inert ingredients (normally clay) are sprayed with the desired amount of active ingredient. Generally, granules are large in size (ranging from 40 to 80 mesh). Granules can be applied to turf with a fertilizer spreader or incorporated directly into the soil.
Examples: Compass G; Andersons Bayleton etc.

Emulsifiable Concentrates (EC): A liquid fungicide, insoluble in water, dissolved in an organic solvent. An emulsifying agent is incorporated in the formulation, so when the product is mixed with water, an emulsion is formed. When the product is added to water it forms a "milky" mixture consisting of the active ingredient and the emulsifier. An emulsion is a suspension of very tiny droplets of the solvent/fungicide in water. Once mixed with water in a spray tank, an EC can require some agitation to maintain a suspension.

Flowables (F or L): Flowables are insoluble fungicides ground into very fine particles, usually by a wet grinding process, and impregnated on a carrier such as clay or talc. The active ingredient is mixed with a liquid and an inert ingredient to form a suspension. The liquid is thick and requires dilution in water before application. Flowables remain suspended in water for relatively long periods of time, but they should be agitated before use. Flowables are dust-free, easy to mix, remain in suspension longer than wettable powders, and may also resist washing off the plant better than wettable powders. They need to be protected from freezing, however.
Example: Lesco Twosome

Water Dispersible Granules (WDG) or Dry Flowable (DF): The two names are interchangeable with one another. These are similar to wettable powders. The active ingredient is prepared as granule-sized particles and must be mixed with water. The small granules can be poured from a container like a liquid. They are virtually dust-free, more readily measured than wettable powders, and disperse easily in water to form a suspension. They require constant agitation and cause some nozzle wear on spray equipment.
Examples: Heritage, Spectro, Systar, Buscalid

Fumigants: Fumigants are chemicals that turn into a poisonous gas after application. They are generally used for soil fumigation. Some are formulated only as gases, while others are liquids that turn to gas when injected into the soil. Advantages of fumigants include toxicity to a wide range of pests and effectiveness with a single application. The area treated with fumigants must be enclosed or covered, and special safety and application equipment are needed.
Example: Curfew

Classification of Turfgrass Fungicides

Fungicides may be classified by similarities in their chemical structure, topical activity and mode of action.

Chemical Structure: There are 13 chemically related groups or "chemical families" of fungicides (Table 1).

Fungicides in a common chemical family are similar in their topical activity and mode of action. If a fungus develops resistance to one fungicide in a chemical family, then it is usually resistant to other fungicides in the same family.

Topical Activity: Topical activity refers to the fungicide's activity. According to their site of interaction, fungicides can be divided into two main categories:

Contact: A contact fungicide kills or inhibits the fungus that it comes in contact with. These fungicides can also be applied to leaves, but can only inhibit the growth of the fungus if it is present on the leaf surface. Contact fungicides do not enter the plant.

Systemic: Fungicides that have systemic qualities are absorbed by leaves or roots and transported within the plant to provide fungicidal activity. Some systemics move short distances from the site of application, such as across a leaf blade (local systemic or translaminar). Some fungicides are weakly systemic and can move farther from the application site than local systemics.

Most systemics move more extensively because they are mobile in xylem tissue. When applied to the root zone, these are absorbed by roots and then move upward through the plant with the transpiration stream (xylem-mobile systemic).

Xylem-mobile systemics applied to leaves move throughout the leaf where deposited, but cannot be redistributed out of that leaf; however, any material deposited on stems can move upward into leaves. Phloem-mobile systemics (also known as "true" or amphimobile systemics) have bi-directional mobility; some material moves in phloem out of the leaf where it is deposited upward to other leaves and downward to roots. Systemics cannot move again after translocation.

Mode of Action: Mode of action refers to physiological processes of the fungus that are affected by the fungicide. Fungal processes affected are normally at the cellular level. Fungicidal action can be expressed in one of two visible ways: (1) inhibition of fungal growth and (2) inhibition of spore germination.
Becoming familiar with a fungicide=s mode of action is important for resistance management, and for incorporating fungicides with different modes of action into a disease management program.

There are four categories of fungicide mode of action. Each of the four categories are discussed in detail below with examples of chemical families and specific fungicides that fit each category.

Specific examples of each of the fungicides within these categories are included in Table 1.

Electron Transport Chain Inhibition: The specific members of this group inhibit mitochondrial respiration, which blocks the production of energy. Some examples include:

Strobilurins – Members of this family of fungicides are derived from naturally occurring fungicides in edible mushrooms and wood-decaying mushrooms. They provide good control of downy and powdery mildews, leaf spots, rusts and many other turfgrass diseases. Specifically, members in this group contain the active ingredients azoxystrobin, pyraclostrobin, or trifloxystrobin. Specific fungicides that contain strobilurins include Heritage, Compass and Insignia.

Enzyme Inhibition: These fungicides inhibit the action of important fungal enzymes.

Carbamates and Dithiocarbamates – These fungicides are contacts that cause a direct interference with the respiratory processes of the cell and inactivate Sulfyhydroxyl (SH) groups in amino acids, proteins and enzymes. There are several fungicides in this group that are commonly used on turfgrasses to control a broad spectrum of diseases. Specific fungicides in this group include: Dithane, Mancozeb and Manzate.

Carboxamides – The fungicides in this group interfere with respiration of the fungal cells by

blocking the activity of certain respiratory enzymes. Flutolanil (Prostar) is a carboximide that is commonly used in turfgrass disease control.

Copper – Fungicides containing copper are the oldest group of fungicides used for disease control. Their use dates back to the 1700s. The majority of these products are either blue, green, red or yellow powders that are insoluble in water. Copper fungicides are contacts that cause a non specific breakdown of proteins and enzymes and are most effective at controlling leaf spot fungi. Specific examples of fungicides that contain copper include Junction and Kocide.

Aromatic hydrocarbons (substituted aromatics) – These chemicals are diverse in mode of action, but basically they reduce growth rates and sporulation of fungi. Specific fungicides in this family include Terraneb and PCNB.

Phenylpyrrole – The fungicides in this family are systemic in nature, and act by disrupting amino acid metabolism. The majority of the members in this family are insecticides, but some are fungicides. Specific fungicides that include this chemistry are Maxim and Medallion.

Nitriles – Only one member of this group is labeled for disease control on turfgrass, chlorothalonil. This fungicide disrupts normal cell metabolism and the regulation of cell functions. Examples include Daconil.

Inhibition of Nucleic Acid Metabolism and Protein Synthesis

Benzimidazoles – The fungicides in this family cause morphological distortion of germinating spores by inhibiting DNA synthesis (nuclear division). These chemistries are not toxic to fungi in their initial form but are broken down into metabolites that are toxic to fungi. Active ingredients with this specific chemistry used for turfgrass control are limited to thiophanate-methyl. Specific fungicides that contain this active ingredient are Cleary's 3336, Topsin and Cavalier.

Phenylamides – These materials depress nucleic acid synthesis by decreasing the levels of RNA synthesis. The fungicides in this family provide good control of soil-borne diseases caused by omycetes, which include Phytophthora and Pythium. Active ingredients in the family include mefenoxam, metalaxyl, and oxadixyl. Specific fungicides containing these active ingredients include Subdue MAXX.

Dicarboximides – Inhibit DNA and RNA synthesis, cell division and cellular metabolism. Chemistries in this family are effective at controlling a wide range of pathogenic fungi including Fusarium, Rhizoctonia and Sclerotinia. Active ingredients in this family include iprodione and vinclozolin. Specific products available include Touché, Chipco 26019 and Vorlan.

Sterol Synthesis Inhibition: Ergosterol is the major sterol in most fungi and is essential for membrane structure and function. Ergosterol is the target of fungicides that inhibit sterol synthesis. Examples include:

Demethylation inhibitors (DMI) – This group of fungicides is also referred to as the sterol biosynthesis inhibitors (SBIs). The fungicides in this group work specifically by inhibiting the synthesis of ergosterol, which is necessary for the formation of the cell membrane. One of the vital functions of the cell membrane is to protect cell contents from outside chemicals by screening what flows into the cells. There are subgroupings within the DMIs that include the pyrimidines and the triazoles. Active ingredients in the DMI group include fenarimol, mycobutanil, triadimefon and propiconazole. Specific fungicides that are demethylation inhibitors include Rubigan, Eagle, Banner Maxx and Bayleton.

Antibiotics – They specifically interfere with fungal cell wall synthesis by inhibiting chitin synthase. Examples of fungicides that are chitin synthase inhibitors include Endorse.

Multi-Site Activity

Phosphonates – The mode of action of the members of this group is complex and includes both direct and indirect mechanisms. One example is fosetyl-Al, which is registered for control of Pythium blight on turfgrasses. Once fosetyl-Al enters the plant, it degrades to phosphonate (phosphonic acid), which functions as a fungicide. In general the members of this group have direct fungitoxic activity against fungi and enhance the plant's natural defenses. Specific fungicides in this group include Aliette and Prodigy.

Table 1. List of specific chemical families and the common and trade names of those products within each chemical family.

Chemical Family	Common Name	Trade Name	Type/Mode of Action
Aromatic hydrocarbons	chloroneb	Anderson's Fungicide V 6.25GAnderson's Turf Fungicide 7.5GTermec SP, Terraneb SPProturf Fungicide V	Protectant fungicide Mode of action: Interferes with mitosis.
	etridiazol (ethazole)	Koban 30WP, Terrazole 35WP	
	PCNB	Anderson's 10-0-14 Fertilizer + 15% PCNB, Anderson's FFII 15 .4G (14-3-3), Cleary's PCNB, Defend 4F, Defend 75WP, Defend 10G, 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, Turfgo	
Benzimidazoles	thiophanate methyl	Absorb TM, Anderson's Systemic Fungicide 2.3G, Cavalier, Cleary's 3336 50W/WSP, Cleary's 3336 2G, Cleary's 3336 4.5F, Fungo Flo AGC, Fungo 4.5F, Fungo Flo 50WSB, Lesco T-Storm (50WSP & Flowable), OHP 6672 (4.5L & 50W), Proturf Systemic Fungicide, Scott's Lawn Fungus Control, Systec 1998 85WDG, Topsin	Systemic Mode of action: Fungicide binds tubulin subunits that results in mitotic arrest.
	thiophanate methyl + chloroneb	Anderson's Turf Fungicide IX(1.63% + 3.26%) 4	
	thiophanate methyl + chlorothalonil	9G ConSyst 66WDG, Spectro 90WDG	
	thiophanate methyl + flutolanil	SysStar WDG (28.58% + 51.42%)	
	thiophanate methyl + iprodione	Anderson's Fluid Fungicide (19.65% + 19.65%))	
	thiophanate methyl + mancozeb	Durosan, Zyban	
Carboxamides	flutolanil	Prostar 70WP	Systemic; blocks activity of certain respiratory enzymes.
	boscalid	Emerald 70EG (WDG)	Blocks activity of certain respiratory enzymes.

Table 1. List of specific chemical families and the common and trade names of those products within each chemical family.

Chemical Family	Common Name	Trade Name	Type/Mode of Action
Demethylation Inhibitors (DMI)	fenarimol	Rubigan A.S., Rubigan E.C.	Systemic Mode of action: Sterol inhibitor (ergosterol); inhibits cell membrane synthesis.
	fenarimol + chlorothalonil	Lesco TwoSome 4F	
	myclobutanil	Anderson's Golden Eagle 0.39G, Eagle 20EW, Eagle 40WP, Eagle WSP	
	myclobutanil + mancozeb	MANhandle (2.25% + 60%)	
	propiconazole	Banner Maxx 1.24 MEC, Banner GL 3.6WSP, Lesco Spectator 3.6EC, Propiconazole Pro 1.3MEC; Quali-pro propiconazole 14.3	
	triadimefon	Accost 1G, Anderson's Fungicide VII 0.59G, Anderson's 1% Bayleton 1G, Bayleton 25WP, Bayleton 50WSP, Lebanon Bayleton 1G, Lesco Granular turf fungicide 1G, Lesco Systemic fungicide contains 50% Bayleton, Pro Bayleton, Proturf Fungicide VII	
	triadimefon + flutolanil	Prostar Plus	
	triadimefon + metalaxyl	Anderson's Fluid Fungicide II (16% triadimefon + 16% metalaxyl)	
	triadimefon + thiram	Fluid Fungicide III F (1.59% + 40.76%)	
Dicarboxamides	iprodione		
	vinclozolin		
Carbamates and Dithiocabamates	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,	Protectant fungicide Mode of action: Enzyme inactivation

Table 1. List of specific chemical families and the common and trade names of those products within each chemical family.

Chemical Family	Common Name	Trade Name	Type/Mode of Action
Carbamates and Dithiocabamates *(continued)*	mancozeb	Manhandle, ManKocide, Manzate 75DF, Manzate Flowable Protect T/O	Protectant fungicide Mode of action: Enzyme inactivation
	mancozeb + copper hydroxide	Junction 60DF, Junction 61WF	
	Maneb	Maneb Plus Zinc F4, Maneb 75DF, Pentathlon 4F, Pentathlon 75DG	
	propamocarb hydrochloride	Banol	Localized penetrant. Mode of action: Alters cell membrane function.
	propamocarb + chlorothalonil	Lesco Par 6.25F	
Copper	copper hydroxide	Kocide 2000 TNO, Nu-Cop	Protectant Mode of action: Non-specific breakdown of proteins and enzymes.
Nitriles	chlorothalonil	Anderson's 5% ChloroStar 6F, 82.5WDG, Concord DF, Concord SST 6F, CountDown, Daconil 5G, Daconil Ultrex, Daconil Weatherstik, Daconil Zn, Echo DF, Echo 500, Manicure, Evade, Prograde 500, 75WDG, Lebanon Daconil 5G, Lesco Manicure T/O, 6F, Thalonil, Ultrex 82.5WDG	Protectant fungicide Mode of action: Toxic to cell membrane.
	chlorothalonil + propiconazole	Echo Propiconazole Turf Fungicide Co-Pack 75WDG + 3.6EC	
Phenylamides	metalaxyl	Subdue 2E, Proturf Pythium Control, Apron (seed treatment)	Systemic Mode of action: Inhibits RNA synthesis.
	mefenoxam	Anderson's Pythium Control 1.2G, Apron XL LS, Mefanoxam 2, Quell, Ridomil Gold EC, Subdue GR, Subdue Maxx, Subdue WSP, Tri-Power Selective	
Phenylpyrrole	fludioxinil	Maxim 4FS, Medallion	Protectant Mode of action: Disrupts amino acid metabolism.

Table 1. List of specific chemical families and the common and trade names of those products within each chemical family.

Chemical Family	Common Name	Trade Name	Type/Mode of Action
Phosphonates	fosetyl-A1	Aliette 80WP, Aliette WDG, Chipco Signature, Prodigy Signature, Lesco Prodigy Signature 80DG, Monterey Aliette (new homeowner product), Terra Aliette T/O, 80WDG	Systemic fungicide Mode of action: General fungitoxic effect.
	phosphite (salts of phosphorus acid)	Magellan, AGRI-FOS (CA), Fosphite, Reliant	
Strobilurins	azoxystrobin	Heritage, Heritage TL	Systemic. Mode of action: ATP inhibition
	pyraclostrobin	Insignia 20WDG	Localized penetrant. Mode of action: ATP inhibition
	trifloxytrobin	Compass 50WDG, Compass 50WSP, Compass G	Localized penetrant. Mode of action: ATP inhibition
	fluoxastrobin	Disarm	Localized penetrant. Mode of action: ATP inhibition
Antibiotic	Polyoxin D	Endorse	Localized penetrant. Mode of action: Inhibits chitin production, which is a major component of the cell wall in many fungi; inhibits spore germination.
Hydrogen dioxide	Zerotol	Peroxyacetic acid/ Hydrogen peroxide	Contact fungicide. Biosafe systems.
Potassium bicarbonate	Kaligreen	Potassium bicarbonate	AgBio
Dipotassium Phosphate	Biophos	Phosphate	AgBio

Table adapted and modified from Martinez, A. 2009. Turfgrass Disease: Pest Control Recommendations for Professionals. Cooperative Extension, University of Georgia College of Agricultural and Environmental Sciences.

Table 2. Turfgrass fungicides sold as pre-packed mixtures.*	
Active Ingredients	**Product Names**
copper hydroxide + mancozeb	Junction
fenarimol + chlorothalonil	Lesco Twosome
propiconazole + chlorothalonil	Echo Propiconazole Turf Fungicide
propamocarb + chlorothalonil	Lesco Par
iprodione + thiophanate methyl	26/36 Fungicide, Proturf Fluid Fungicide
metalaxyl + triadimefon	Proturf Fluid Fungicide II
myclobutanil + mancozeb	MANhandle
thiophanate methyl + chloroneb	Proturf Fungicide IX
thiophanate methyl + chlorothalonil	ConSyst, Spectro, Broadside
thiophanate methyl + flutalonil	Systar, Prostar Plus
thiophanate methyl + mancozeb	Duosan
thiophanate methyl + thiram	Bromosan
triadimefon + thiram	Proturf Fluid Fungicide III
triadimefon + flutolanil	Prostar Plus
triadimefon + trifloxystrobin	Armada, Tartan
azoxystrobin + propiconazole	Headway
* Adapted and modified from Vincelli, P., and A.J. Powell. 2006. Chemical Control of Turfgrass Diseases. http://www.ca.uky.edu/agc/pubs/ppa/ppa1/ppa1.pdf	

Biofungicides

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

Table 3. Biofungicides labeled for turfgrass.		
Trade Name	**Active Ingredient**	**Company**
Ecoguard	*Bacillus licheniformis* SB 3086	Novozymes
Rhapsody	*Bacillus subtillis* QST 713	Agraquest

Efficacy of Turfgrass Fungicides

Table 4. Efficacy of turfgrass fungicides and cross reference fungicides/disease controlled.

	Anilides	Aromatic hydrocarbons		Benzamide	Benzimidazole	Carbamate
Disease	**boscalid**	**chloroneb**	**etridiazole**	**flutolanil**	**thiophanate methyl**	**propamocarb**
Algae						
Anthracnose						
Brown Patch						
Dollar Spot						
Fairy Ring						
Gray Leaf Spot						
Large Patch						
Leaf Spot/Melting Out						
Pythium Blight/Root Rot						
Rust						
Spring Dead Spot						
Summer Patch						
Take All Patch						
Yellow Patch						

	Dicarboximides			DMIs		
Disease	**iprodione**	**vinclozolin**	**fenarimol**	**myclobutanil**	**propiconazole**	**triadimefon**
Algae						
Anthracnose						
Brown Patch						
Dollar Spot						
Fairy Ring						
Gray Leaf Spot						
Large Patch						
Leaf Spot/Melting Out						
Pythium Blight/Root Rot						
Rust						
Spring Dead Spot						
Summer Patch						
Take All Patch						
Yellow Patch						

	EBDC	Nitrile	Phenylamide	Phenylpyrole
Disease	**mancozeb**	**chlorothalonil**	**mefenoxam**	**fludioxonil**
Algae				
Anthracnose				
Brown Patch				
Dollar Spot				
Fairy Ring				
Gray Leaf Spot				
Large Patch				

	EBDC	Nitrile	Phenylamide	Phenylpyrole
Disease	**mancozeb**	**chlorothalonil**	**mefenoxam**	**fludioxonil**
Leaf Spot/Melting Out	■	■		
Pythium Blight/Root Rot	————		■	
Rust	■	■		
Spring Dead Spot				
Summer Patch				▞▞▞
Take All Patch				
Yellow Patch		————		————

	Phosphonate	QoI		
Disease	**fosetyl-Al**	**azoxystrobin**	**pyraclostrobin**	**trifloxystrobin**
Algae				
Anthracnose		■	■	————
Brown Patch		■	■	■
Dollar Spot			————	▞▞▞
Fairy Ring		■		
Gray Leaf Spot		■	■	————
Large Patch		■	▞▞▞	
Leaf Spot/Melting Out		■	■	
Pythium Blight/Root Rot	■	————	▞▞▞	▞▞▞
Rust		■		
Spring Dead Spot		■		
Summer Patch		■	————	■
Take All Patch		■	▞▞▞	
Yellow Patch				

This efficacy table has been prepared based on Vincelli, P., and A.J. Powell. 2009; L. Treadway handouts, Turfgrass Disease Update at North Carolina Turfgrass Association meeting, 2009; Fungicide and Nematicide Tests - APS several issues; L. Burpee research results and personal observations, and A. Martinez research results and personal observations.

■	Excellent control when conditions highly favorable for disease development.
■	Good control when conditions highly favorable for disease development.
————	Good control when disease pressure is moderate.
▞▞▞	Good control when disease pressure is low.
	Not Applicable

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 rate specified in the label.
- Use compatible tank mixes at recommended label rates.
- The best control is achieved by applying fungicides preventively.
- Fungicides should be sprayed when air temperatures are between 60 degrees F and 85 degrees F (15.3 degrees C and 29.4 degrees 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/1,000 sq feet 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.

Turfgrass Fungicide Resistance Management

In general, fungicide resistance can be defined as an adjustment by a fungal population to the use of a particular fungicide. This adjustment will result in reduced effectiveness and control of the particular fungicide in question. The most important thing to remember when using fungicides is to read the label provided with them. Only apply the fungicide at the rate that is allowed by the law, and only spray the chemical on the provided label spray cycle.

Decreasing the rate or decreasing the number of days between sprays on your own will only increase the likelihood of developing a resistant fungal population. Some fungicides have a higher risk of creating a resistant fungal population. An example of a chemical family that has developed resistance is the phenylamides. One specific fungicide in this family is Subdue (metalaxyl).

In general, protectant fungicides have a low risk of fungal populations developing resistance to them. Systemic fungicides are most at risk. Systemic fungicides act on a single site in the fungal cell, and their mode of action is so specific that a simple natural mutation may occur in the target fungus. This can lead to the buildup of resistant populations of fungi. Widespread or repeated use of the fungicide will then result in chemical control failure. The four systemic fungicide families most at risk for resistance are the benzimidazoles, dicarboxamides, demethylation inhibitors (DMIs), and the strobilurins.

Strategies that can be implemented to reduce the onset of resistance are aimed at delaying the development of fungicide resistance. The most effective strategies include:

Use fungicides only when you need to. In some cases, cultural control measures can be implemented to decrease disease and reduce the use of chemical controls.

Alternate fungicides that have different modes of action or sites of action (refer to Table 1). This will act to reduce the time of exposure that a fungus has to any one mode of action. For example, there are several different chemistries that can be used to control dollar spot. Not all of these chemistries are in the same chemical family. Members of the nitriles (chlorothalonil), anilides (boscalid), demethylation inhibitors (fenarimol), and dithiocarbamates (mancozeb) all have the ability to control dollar spot. Also, not all of the chemistries that can be employed are systemic fungicides. Using a variety of products that will limit the exposure of *Sclerotinia homoeocarpa* to any one formulation reduces the risk of a resistance build-up in the fungal population.

Turfgrass Fungicide Costs

Cost of fungicide requires a range of consideration including: price from vendor, cost per ounce, label application rates, application intervals, and cost per day.

Vendor Price Lists. This will include the actual price of the fungicide. Lists will be more useful if they contain size of the product and quantity per unit. Other considerations include availability of other products within the same chemical group, past performance of the fungicide, diseases that the fungicide controls, protection interval, fungicide resistance management and date that the product will be delivered.

Cost per ounce. Convert the price to a cost per ounce by taking the total cost of the product and dividing by the total number of ounces.

Application interval. A key element to consider when purchasing a fungicide is the application interval or how long is the fungicide going to control a particular pathogen.

Application rate. Consider labeled rate, disease pressure and disease to control. Many labels include preventative and curative rates.

Cost per day. A valuable indicator to evaluate the cost of a particular fungicide is the cost of control per day. This can be calculated by taking the application rate then multiplying it by the cost of product on a per ounce basis, then dividing the result by the application interval.

Product	Rate/1000 sq ft (max)	Application Interval (max)	Cost per ounce $	Cost per 1000 sq ft $	Cost per day $
Product A	0.4 oz	28 days	42.00	16.80	0.60
Product B	2.0 oz	28 days	5.00	10.00	0.35
Product C	10 oz	14 days	0.88	8.80	0.62

Turfgrass Fungicide Internet Resources

1. **www.cdms.net** from Crop Data Management Systems. There are more than 1,600 product labels and over 4,400 MSDS, searchable products, update new label registration.

2. **www.ca.uky.edu/agc/pubs/ppa/ppa1/ppa1.pdf.** Yearly update on turfgrass fungicides tailored for the state of Kentucky. Written and maintained by Dr. P. Vincelli, and D. Williams.

3. ***Georgia Pest Management Handbook*** **www.ent.uga.edu/pmh.** Comprehensive yearly special bulletin published by Cooperative Extension, University of Georgia College of Agricultural and Environmental Sciences.

4. ***2009 Turfgrass Pest Control; Recommendation for Professionals.*** Yearly special bulletin tailored for turfgrass professionals published by published by University of Georgia Cooperative Extension, College of Agricultural and Environmental Sciences in cooperation with the Georgia Turfgrass Association.

5. ***Turfgrass Diseases in Georgia: Identification and Control.*** **http://pubs. caes.uga.edu/caespubs/pubcd/B1253/B1233.html.** Martinez, A. et al. 2009. Comprehensive publication with description of turfgrass diseases and practical recommendations for disease management.

6. ***Abiotic Injuries and Disorders of Turfgrasses in Georgia.*** **http://pubs.caes.uga.edu/caespubs/pubcd/B1258/B1258.html.** Martinez et al 2009. Comprehensive publication with description of turfgrass most common injuries and disorders and practical recommendations for their management.

7. **FRAC. Fungicide Resistance Action Committee. http://www.frac.info/ frac/index.htm** FRAC is a Specialist Technical Group of CropLife International. The purpose of FRAC is to provide fungicide resistance management guidelines to prolong the effectiveness of "at risk" fungicides and to limit crop losses should resistance occur.

Bibliography

http://www.cdms.net

Vincelli, P., and A. J. Powell. 2006. *Chemical Control of Turfgrass*. www.ca.uky.edu/agc/ pubs/ ppa/ppa1/ppa1.pdf

http://www.pesticidemanual.com/

http://www.bcpcbookshop.co.uk/downloads/ boscalid.pdf

http://www.bcpcbookshop.co.uk/

http:/www.ent.uga.edu/pmh. 2009. *Georgia Pest Management Handbook.* Cooperative Extension, University of Georgia College of Agricultural and Environmental Sciences.

Martinez, A. Turfgrass Disease. *In:* Waltz et al, 2009. *2009 Turfgrass Pest Control: Recommendations for Professionals.* Cooperative Extension, UGA College of Agricultural & Environmental Sciences.

Martinez A., L. Burpee, and C. Waltz. 2009. *Abiotic Injuries and Disorders of Turfgrasses in Georgia.* Cooperative Extension, UGA College of Agricultural and Environmental Sciences. Bulletin B1258.

Martinez, A, M. Pearce, and L. Burpee. 2009. *Diseases of Turfgrasses in Georgia: Identification and Control.* Cooperative Extension, UGA College of Agricultural and Environmental Sciences. Bulletin 1233.

Hewitt, H.G.1998. F*ungicides in Crop Protection.* New York: Cab International.

Hutson, D., and J. Miyamoto. (Eds). 1998. *Fungicidal Activity: Chemical and Biological Approaches to Plant Protection.* New York: John Wiley and Sons.

Gnanamanickman, S.S. 2002. *Biological Control of Crop Diseases.* New York: Marcel Dekker, Inc.

Disclaimer

1. Listing fungicides implies no product endorsement by the University of Georgia nor its representatives. Omission and criticism of products not mentioned is neither implied nor intended.

2. This bulletin is for informational purposes only. The University of Georgia does not accept any responsibility for omissions, errors or future amendments.

3. Always read and follow label directions.

ATTENTION!

Pesticide Precautions

1. Observe all directions, restrictions and precautions on fungicide labels. It is dangerous, wasteful and illegal to do otherwise.

2. Store all fungicides in original containers with labels intact and behind locked doors. **"KEEP PESTICIDES OUT OF REACH OF CHILDREN."**

3. Use fungicides at correct label dosage and intervals to avoid illegal residues or injury to plant and animals.

4. Apply fungicides carefully to avoid drift or contamination of non-target areas.

5. Surplus fungicides and containers should be disposed of in accordance with label instructions so that contamination of water and other hazards will not result.

6. Follow directions on the fungicide label regarding restrictions as required by State and Federal Laws and Regulations.

7. Avoid any action that may threaten an Endangered Species or its habitat. Your County Extension Agent can inform you of Endangered Species in your area, help you identify them and through the Fish and Wildlife Service Office identify actions that may threaten Endangered Species or their habitat.

Trade names are used only for information.

Learning for Life

Bulletin 1316 **Revised February 2010**