



Weed, Insect, and Disease Control

FOR TURFGRASS PRODUCERS

FIRST EDITION



Interpreting Product Labels

Product labels contain vast amounts of information that can aid in proper and effective application. Much of the information on the label is designed to provide the applicator with important information on use sites, rates, restrictions, personal protective equipment (PPE), restricted entry intervals (REI), tank-mix compatibility, adjuvants, application timing, spray volume, and more. While product labels can often vary in length, there are a few fundamental components to each label that are of particular importance. A few of these terms are highlighted in the sample label below and are included throughout this guide. As always, the label is the law so be sure to read and follow all directions before, during, and after application to ensure safe, effective use.

Some of the information about products listed in this guide includes, but is not limited to the following:

Common name – Products are listed alphabetically by the common name of the primary active ingredients.

Trade name – Products with the same primary active ingredients are often sold under different trade names, particularly in different countries. There may be trade names and product formulations beyond the ones listed.

Application rate – Application rates are provided in various units based on product labels. Examples include pounds per acre (lb/acre), ounces per acre (oz/acre), fluid ounces per 1,000 square feet (fl oz/1,000 ft²), etc.

Application interval – Recommended intervals between applications are based on the product label but vary depending on such factors as pest pressure/severity and acceptable damage thresholds.

Mode of action – Information on a product's mode of action (MOA) is listed to help applicators rotate MOAs to prevent resistance from developing or to manage populations of weeds, insects, or diseases that are already resistant:

- **HRAC, WSSA Code:** The herbicidal MOA as defined by the Herbicide Resistance Action Committee (HRAC) and the Weed Science Society of America (WSSA)
- **IRAC Code:** The insecticidal mode of action as defined by the Insecticide Resistance Action Committee (IRAC)
- **FRAC Code:** The fungicidal mode of action as defined by the Fungicide Resistance Action Committee (FRAC)

Comments – Notes and cautions can help you improve control and learn about restricted-use pesticides, use sites, turfgrass tolerance, etc.

Mode of action (MOA):
(Group 12 Fungicide)
classification based on the
Herbicide, Insecticide, or
Fungicide Resistance Action
Committee (HRAC, IRAC, FRAC)

Trade name:
Lone Star WSP

Common name:
Fludioxonil

GROUP 12 FUNGICIDE

Lone Star WSP

Fungicide

(continued from booklet attached to front of container)

Active Ingredient:

Fludioxonil*	50.0%
Other Ingredients	50.0%
Total:	100.0%

*CAS No. 131341-86-1
Lone Star WSP is a 50% water dispersible granule.

EPA Reg. No. 100-1434
Product of United States
SCP 1434A-L2A 0912 4017353

8 ounces
NET WEIGHT

WSP: Formulation
(water soluble packet).

Product formulations containing synthetic auxin herbicides

Table 6. Synthetic auxin herbicide rates in various products

		ACTIVE INGREDIENT (LB/A)									
		2,4-D	clopyralid	dicamba	dichlorprop (2,4-DP)	fluroxypyr	halauxifen	MCPA	mecoprop (MCP)	triclopyr	quinclorac
Trade name	Rate (per acre)										
2DQ	1-3 pt	0.4-1.2	—	0.04-0.13	—	—	—	—	—	—	0.04-0.12
4Speed ¹	1.8-4 pt	0.5-1.1	—	0.05-0.11	—	—	—	—	0.13-0.29	—	—
4Speed XT1	1.8-4 pt	0.5-1.1	—	0.05-0.11	—	—	—	—	—	0.05-0.11	—
Avenue South ^{2,3}	2.7-5 pt	0.18-0.33	—	0.05-0.09	—	—	—	—	—	—	—
Banvel	0.5 pt- 2 qt	—	—	0.25-2	—	—	—	—	—	—	—
Battleship III	3-4 pt	—	—	—	—	0.11-0.15	—	1.1-1.4	—	0.10-0.14	—
ChangeUp	2-3 pt	—	—	0.10-0.15	—	0.10-0.15	—	1.0-1.5	—	—	—
Clean Slate	0.25-.33 pt	—	0.1-0.5	—	—	—	—	—	—	—	—
Confront	1-2 pt	—	0.1-0.2	—	—	—	—	—	—	0.28-0.56	—
Cool Power	2.5-3.5 pt	—	—	0.09-0.13	—	—	—	0.9-1.3	—	0.09-0.13	—
Drive XLR8	22-64 oz	—	—	—	—	—	—	—	—	—	0.25-0.75
EndRun	1.8-4 pt	0.5-1.2	—	0.04-0.1	—	—	—	0.1-0.3	—	—	—
Escalade 2	2-3 pt	0.8-1.2	—	0.1-0.15	—	0.1-0.15	—	—	—	—	—
GameOn	3-4 pt	0.7-1.0	—	—	—	0.15-0.2	0.01	—	—	—	—
Hardball	1-1.75 qt	0.4-0.8	—	—	—	—	—	—	—	—	—
Horsepower	2-3 pt	—	—	0.1-0.14	—	—	—	1.0-1.4	—	0.1-0.14	—
Last Call ⁴	3.5-4 pt	—	—	0.1-0.125	—	0.1-0.125	—	—	—	—	—
Lontrel	0.25-1.33 pt	—	0.1-0.5	—	—	—	—	—	—	—	—
Mecomec 2.5	4-5.17 pt	—	—	—	—	—	—	—	0.6-0.75	—	—
Mecomec 4	2.75-3.5 pt	—	—	—	—	—	—	—	0.6-0.75	—	—
Millennium Ultra 2	1.5-3 pt	0.6-1.1	0.03-0.07	0.07-0.14	—	—	—	—	—	—	—
Momentum FX2	3-4 pt	0.84-1.1	—	—	—	0.10-0.14	—	—	—	0.10-0.13	—
Momentum Q	7-8 pt	0.9-1.0	—	0.10-0.13	—	—	—	—	—	—	0.66-0.75
Momentum 4-Score ²	3.5 to 4.5 pt	0.48-0.62	—	—	—	0.12-0.15	—	—	—	0.11-0.14	—
Onetime	22-64 oz	—	—	0.03-0.1	—	—	—	—	0.13-0.38	—	0.25-0.75
Powerzone ²	2-5 pt	—	—	0.06-0.14	—	—	—	0.6-1.4	0.11-0.28	—	—
Q4 ²	5-8 pt	0.6-0.9	—	0.06-0.1	—	—	—	—	—	—	0.47-0.75
Quincept	7-8 pt	0.9-1	—	0.11-0.13	—	—	—	—	—	—	0.66-0.75
Quinclorac 75DF	1 lb	—	—	—	—	—	—	—	—	—	0.75
RedZone 2 ¹	3-4 pt	0.9-1.1	—	0.09-0.11	—	—	—	—	0.21-0.29	—	—
Solitare ²	1-2 lb	—	—	—	—	—	—	—	—	—	0.56-1.2
SpeedZone ²	2-5 pt	0.4-1	—	0.04-0.09	—	—	—	—	0.12-0.3	—	—
SpeedZone Southern	1.5-5 pt	0.1-0.3	—	0.01-0.03	—	—	—	—	0.05-0.125	—	—
Spoiler	1.7-4 pt	0.6-1.3	—	—	0.15-0.36	—	—	—	0.15-0.36	—	—
Sure Power ⁶	2 to 3.5 pt	0.55-1.0	—	—	—	0.06-0.1	—	—	—	0.06-0.1	—
Surge ²	2.75-4 pt	0.5-0.7	—	0.08-0.11	—	—	—	—	0.17-0.25	—	—
T-Zone ²	2-4 pt	0.4-0.9	—	0.05-0.1	—	—	—	—	—	0.13-0.25	—
Tri-Power	2-3.9 pt	—	—	0.08-0.15	—	—	—	0.8-1.5	0.15-0.3	—	—
Triamine	1.75-4 pt	0.3-0.6	—	—	0.14-0.31	—	—	—	0.14-0.31	—	—
Trimec Bentgrass Formula	3-6 pt	0.2-0.3	—	0.07-0.14	—	—	—	0.3-0.5	—	—	—
Trimec Classic	2-4 pt	0.5-1	—	0.05-0.11	—	—	—	—	0.13-0.27	—	—
Trimec Plus ⁵	8-13.5 pt	0.5-0.8	—	0.12-0.2	—	—	—	—	0.24-0.41	—	—
Trimec Southern	1-3 pt	0.2-0.5	—	0.04-0.11	—	—	—	—	0.17-0.5	—	—
Triplet Low Odor	1.8-4 pt	0.5-1.2	—	0.05-0.11	—	—	—	—	0.14-0.32	—	—
Triplet SF	1.8-4 pt	0.5-1.2	—	0.05-0.11	—	—	—	—	0.14-0.32	—	—
Turflon Ester, Turflon Ester Ultra	1-2 pt	—	—	—	—	—	—	—	—	0.5-1	—
Vanquish	0.5-2 pt	—	—	0.25-1	—	—	—	—	—	—	—
Vision	0.5-2 pt	—	—	0.24-1	—	—	—	—	—	—	—
Vista XRT	—	—	—	—	—	0.13-0.48	—	—	—	—	—
Weedar 64	1-1.5 qt	1.0-1.4	—	—	—	—	—	—	—	—	—

1: Also contains pyraflufen-ethyl, which kills susceptible weeds within 48 hours
 2: Also contains sulfentrazone or cafentrazone, which kills susceptible weeds within 48 hours
 3: Also contains penoxsulam, a systemic ALS-inhibiting herbicide that controls broadleaf weeds

4: Also contains fenoxaprop-P-ethyl, which controls many grassy weeds
 5: Also contains MSMA, which controls some broadleaf and grassy weeds
 6: Also contains flumioxazin, which kills susceptible weeds within 48 hours

Herbicides for commonly occurring weeds

Crabgrass

Preemergence herbicides

Most preemergence herbicides in the section on preemergence herbicides for grassy and broadleaf weeds (table 3; beginning on page 4) provide suitable crabgrass control when applied before crabgrass germination. However, most of these should not be applied to immature turf often present in sod production. See table 4, (intervals for pre-emergence herbicides application in sod production) for more information. Mesotrione is commonly used for annual weed control on immature seeded cool-season turfgrass species while oxadiazon is commonly used on immature sprigged warm-season species.

Crabgrass germination typically occurs in late winter to mid-spring (February to mid-May depending on location), but varies from year to year, based on temperature, rainfall, and location. Crabgrass germination usually begins when the soil temperature at a 2-inch depth reaches 55°F for at least 3 days in temperate climates. Germination may occur throughout the year in tropical climates.

The forsythia (*Forsythia* spp.) plant can be used to time preemergence herbicide application. Make preemergence applications when forsythia is in full bloom (since they are usually among the first plants to bloom, their yellow flowers are easy to spot). Forsythia plants are most prevalent in the eastern United States.

Postemergence herbicides

These herbicides control crabgrass plants at various growth stages after germination. See the comments section and the product label for efficacy and application rates at various growth stages. Most products in table 9 control smooth (*Digitaria ischaemum*) and large (*Digitaria sanguinalis*) crabgrass. Control may vary for other crabgrass species, such as blanket (*D. serotina*), India (*D. longiflora*), and tropical (*D. bicomis*) crabgrass.

If you apply herbicides early in the season in areas where the desirable turfgrass is thin and crabgrass infestations are severe, new crabgrass plants will germinate in the voids after the existing crabgrass plants are controlled. For residual control, consider tank-mixing a preemergence herbicide with the postemergence herbicides in table 9.





Larval (caterpillar) and adult (moth) stages of a cutworm. Although several species of cutworms may occasionally infest turfgrass sod, their relative importance and activity varies regionally. (Pictured: Bronzed Cutworm *Nepheodes minians*)

Table 10. Insecticides registered for control of cutworms in turfgrass production

Chemical Name (active ingredient)	Trade Name	Product/A	Product/1000 ft ²	Notes*
acephate	Acephate 90% Prills	2.7-3 lbs	0.97-1.07 oz	
	Acephate 97 UP	2.5-3.09 lbs	0.9-1.1 oz	
	Acephate 97 WDG	2.5-3.09 lbs	0.9-1.1 oz	
	Bracket 97	2.5-3.09 lbs	0.9-1.1 oz	
	Bracket 97 WDG	2.5-3.09 lbs	0.9-1.1 oz	
	Orthene T-T&O WSP	1.33-3.33 lbs	0.5-1.33 oz	
	Orthene T-T&O 97	1-2.5 lbs	0.4-0.9 oz	
	bifenthrin	Avalon Golf & Nursery	10 fl oz	0.25 fl oz
Bifen 2 AG Gold			0.05-0.08 fl oz	
Brigade 2EC		2.2-3.5 fl oz	0.05-0.08 fl oz	
Capture LFR		2.8-4.35 fl oz	0.066-0.1 fl oz	Rate varies by usage strategy
Fanfare ES		2.2-3.5 fl oz	0.05-0.08 fl oz	
Menace GC 7.9% F		10 fl oz	0.25 fl oz	
Pro-Mate Bifenthrin			0.18-0.25 fl oz	
Sniper		2.2-3.5 fl oz	0.05-0.08 fl oz	
Tailgunner		2.2-3.5 fl oz	0.05-0.08 fl oz	
Talstar GC		50 lbs	1.15 lbs	
Talstar S		10 fl oz	0.25 fl oz	
Up-Star GC		50 lbs	1.15 lbs	
Up-Star SC		10 fl oz	0.25 fl oz	
Wisdom GC		50 lbs	1.15 lbs	
carbaryl	Carbaryl 4L	2-4 qts	1.5-3 fl oz	
	Sevin SL	2-4 qts	1.5-3 fl oz	
chlorantraniliprole	Acelepryn SC	2-4 fl oz	0.046-0.092 fl oz	
	Acelepryn G	50-100 lbs	1.15-2.3 lbs	
chlorpyrifos	Chlorpyrifos 4E	1 qt	0.75 fl oz	
	Chlorpyrifos 4E-AG	1 qt	0.75 fl oz	
	Dursban 50W	2 lbs		
	Govern 4E	1 qt	0.75 fl oz	
	Hatchet	1 qt	0.75 fl oz	
	Lorsban 4E	1 qt	0.75 fl oz	
	Lorsban Advanced	1 qt	0.75 fl oz	
	Vulcan	1 qt	0.75 fl oz	
	Warhawk	2 pts	0.75 fl oz	
	Whirlwind	1 qt	0.75 fl oz	
	Yuma 4E	1 qt	0.75 fl oz	

continued on next page

Table 14. Insecticides registered for control of mole crickets in turfgrass production

Chemical Name (active ingredient)	Trade Name	Product/A	Product/1000 ft ²	Notes*
acephate	Acephate 90% Prills	2.7-3 lbs	0.97-1.07 oz	
	Acephate 97 UP	2.2-3.09 lbs	0.8-1.1 oz	
	Acephate 97 WDG	2.2-3.09 lbs	0.8-1.1 oz	
	Bracket 97	2.2-3.09 lbs	0.8-1.1 oz	
	Bracket 97 WDG	2.2-3.09 lbs	0.8-1.1 oz	
	Orthene T-T&O WSP	3.33-4 lbs	1.33-1.5 oz	
	Orthene T-T&O 97	2.5-3 lbs	0.9-1.1 oz	
bifenthrin	Avalon Golf & Nursery	10-20 oz	0.25-0.5 fl oz	
	Bifen 2 AG Gold		0.16-0.32 fl oz	
	Brigade 2EC	7-14 fl oz	0.16-0.32 fl oz	
	Capture LFR	8.7-17.42 fl oz	0.2-0.4 fl oz	
	Fanfare ES	7-14 fl oz	0.16-0.32 fl oz	
	Menace GC 7.9% F	10-20 fl oz	0.25-0.5 fl oz	
	Pro-Mate Bifenthrin		0.5-1.0 fl oz	
	Sniper	7-14 fl oz	0.16-0.32 fl oz	
	Tailgunner	7-14 fl oz	0.16-0.32 fl oz	
	Talstar GC	100-200 lbs	2.3-4.6 lbs	
	Talstar S	10-40 fl oz	0.25-1 fl oz	
	Up-Star GC	100-200 lbs	2.3-4.6 lbs	
	Up-Star SC	10-20 fl oz	0.25-0.5 fl oz	
	Wisdom GC	100-200 lbs	2.3-4.6 lbs	
chlorpyrifos	Chlorpyrifos 4E	2 qts	1.5 fl oz	
	Chlorpyrifos 4E-AG	2 qt	1.5 fl oz	
	Dursban 50W	4-6 lbs		
	Govern 4E	2 qts	1.5 fl oz	
	Hatchet	2 qts	1.5 fl oz	
	Lorsban 4E	2 qts	1.5 fl oz	
	Lorsban Advanced	2 qts	1.5 fl oz	
	Vulcan	2 qt	1.5 fl oz	
	Warhawk	4 pts	1.5 fl oz	
	Whirlwind	2 qts	1.5 fl oz	
	Yuma 4E	2 qts	1.5 fl oz	
clothianidin	Arena 0.25 G	160 lbs		Suppression only
	Arena 50 WDG	12.8 oz	0.29 oz	Suppression only
deltamethrin	Deltagard GC		2-3 lbs	
dinotefuran	Zylam Liquid	4.9 pts	1.8 fl oz	
	Zylam 20 SG	2.7 lbs	1 oz	
fipronil	Chipco Choice	12.5-25 lbs	4.6-9.4 oz	Sub-surface placement only
	Topchoice	87 lbs	2 lbs	
imidacloprid	AmTide 2F T&O	25.6 oz	0.6 fl oz	
	ArmorTech IMD 2SC	1.6 pts	0.6 fl oz	
	Bandit 75 WSP			1.6 oz (1 packet) per 8,250 ft ²
	Criterion 2F	1.6 pts	0.6 fl oz	
	Criterion 75 WSP			1.6 oz (1 packet) per 8,250 ft ²
	GrubOut 0.2%	200 lbs	4.5 lbs	
	Malice 75 WSP			1.6 oz (1 packet) per 8,250 ft ²
	Mallet 2F T&O	1.6 pts	0.6 fl oz	
	Merit 2F	1.6 pts	0.6 fl oz	
	Merit 75 WP	8.6 oz	4 tsp.	
	Merit 75 WSP			1.6 oz (1 packet) per 8,250 ft ²
	Prokoz Zenith 2F	1.6 pts	0.6 fl oz	
	Prokoz Zenith 75 WSP			1.6 oz (1 packet) per 8,250 ft ²

continued on next page

Turfgrass diseases

Infectious disease occurs when three factors integrate simultaneously – a susceptible host, a virulent pathogen, and a conducive environment. Like humans, turfgrasses are more susceptible to infection when not healthy and actively growing. Plants are more likely to contract a disease when continuously exposed to abiotic environmental stressors (i.e. heat, drought or flooded conditions, etc.), or stresses invoked by high or improper maintenance practices (i.e. low mowing height, lack or excessive fertility, overirrigation, etc.). Growing the right plant (turfgrass species and cultivar) in the right place under the right conditions will limit or prevent turfgrass disease occurrence.

Turfgrass management involves growing individuals of the same or similar genotype very close together, meaning pathogen dissemination and disease transmission is relatively easy and occurs quickly. Therefore, even under proper management, fungicides may be necessary and are recommended for protection of high amenity turfgrasses. Correct and judicious fungicide use requires knowledge of the biology of the pathogen, including where the pathogen infects the plant and the environmental conditions required for infection. These two factors greatly influence the necessary methods for fungicide delivery and application timing to maximize disease control.

Fungicide Delivery: Different pathogens can infect different parts of the plant. Foliar pathogens cause diseases such as brown patch and pythium blight and infect leaves and sheaths. The location of infection for soilborne diseases such as spring dead spot or summer patch is stolons, rhizomes or roots. Fungicides must be effectively delivered to the location of infection. This is particularly crucial for soilborne diseases because most fungicides move upward in the plant, and will not move downward into the rootzone to a depth greater than they are applied. Therefore, fungicides targeting soilborne disease must be either applied in higher carrier volumes

(3-5 gallons/1000 sq ft) or, perhaps more effectively, be watered in with at least 1/8 inch (3 mm) of post-application irrigation.

Application Timing: Preventing disease and turfgrass loss often relies on applying fungicides not when symptoms occur, but earlier in the disease cycle when infection occurs. As with fungicide delivery, this is particularly true for control of many soilborne diseases which can infect and cause root loss prior to symptom development. For instance, the spring dead spot pathogen infects and inhibits the bermudagrass' ability to overwinter in the fall before symptoms ever appear the following spring. Therefore, fall and not spring applied fungicides are necessary for effective control of this disease. Several foliar diseases, such as dollar spot and pythium blight, can cause symptoms rapidly, and are also most effectively controlled preventively. See each disease description for information regarding timing.

Fungicide Resistance: As with other pests, pathogen populations can develop resistance to fungicides when exposed to repeated applications. In many cases, the population doesn't just contract resistance to the one fungicide active ingredient or product that's been used, but will also acquire resistance to all the fungicides that are in that class or mode of action. Therefore, rotating fungicide classes for pathogens that are known to develop resistance is critical to a long-term control strategy. This being said, not all turfgrass pathogens have the same propensity to develop resistance. Take brown patch for instance. Despite repeated applications targeting this disease, no instances of fungicide control failure of brown patch have been observed due to fungicide resistance. Below is a table listing turfgrass pathogens and fungicide classes with known cases of fungicide resistance.

Table 1. Location of infection for turfgrass diseases



FOLIAR 	ROOTS, STOLONS, RHIZOMES 
Anthracnose	Fairy Ring
Brown Patch	Nematodes
Dollar Spot	Spring Dead Spot
Gray Leaf Spot	Summer Patch
Large Patch	
Leaf Spots/Melting Out	
Microdochium Patch	
Pythium Blight	
Red Thread	
Rust	
Snow Molds	

Table 2. Turfgrass diseases with known cases of fungicide resistance

Disease	Chemical Class
Anthracnose	Benzimidazoles
	DIMs
	Strobilurins (QoI)
Dollar Spot	Benzimidazoles
	Dicarboximides
	DIMs
	SDHI
Gray Leaf Spot	Strobilurins (QoI)
Pythium Blight	Phenylamides
Microdochium Patch	Benzimidazoles
	Dicarboximides

Cool Season Turfgrass Diseases

Many more diseases occur on cool season turfgrasses, and in general they cause more severe damage than those affecting warm season turfgrasses. Symptoms generally occur in the heat of the summer when cool season turfgrass is under a higher level of stress. Several diseases, however, occur in milder temperatures in the spring and fall, and diseases like the snow molds can even occur under snow cover.

Anthracnose FOLIAR

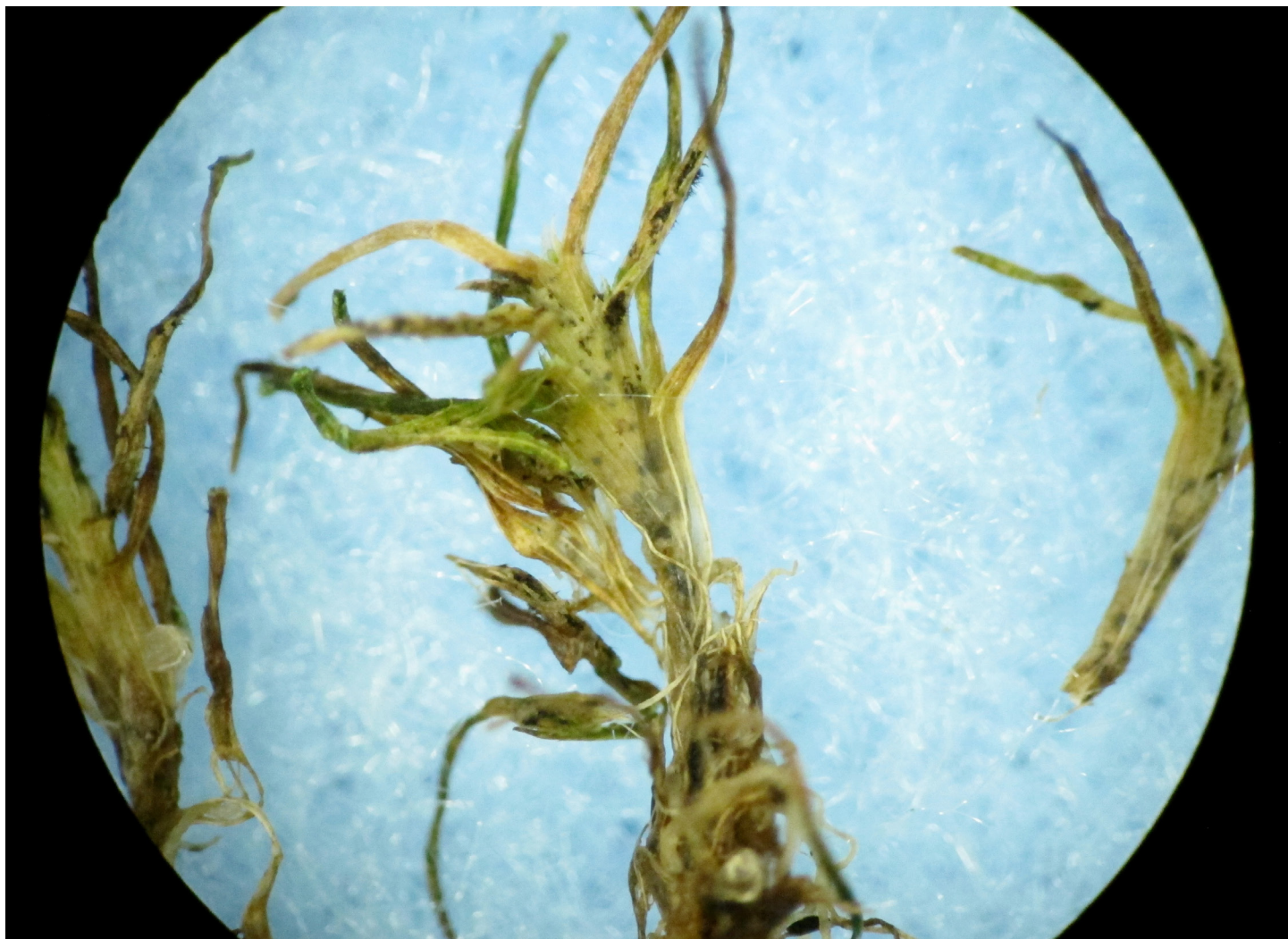
Pathogen: *Colletotrichum cereale*

Main Host: Annual bluegrass (*Poa annua*), Creeping bentgrass

Description: Anthracnose can occur on golf putting greens as either a foliar blight or a more damaging basal crown rot. The disease is much more destructive and frequently observed on *Poa annua* than creeping bentgrass, but even some modern creeping bentgrass cultivars can get damaging basal rot symptoms. Although the disease can occur in milder temperatures, symptoms are most commonly seen during hot, humid weather in early or late summer. From a distance,

symptoms can be highly variable but most often appear as small yellow, orange or reddish-brown freckle-like spots less than 2 inches (5 cm) in diameter that if left untreated may merge to form larger patches. On individual plants affected with foliar blight, characteristic hair-like projections called setae can be observed on leaf tissue with a small microscope or hand lens. Leaf sheaths, crowns and stolons will be dark black and rotted on plants affected with anthracnose basal rot symptoms.

Control: Anthracnose symptoms are most severe in areas that are stressed by low mowing, excessive traffic, low fertilization or irrigation. A frequent low-nitrogen rate fertility program through the late spring and summer and raising cutting heights can result in marked decreases in anthracnose severity. In the basal rot phase of the disease, applying fungicide in a higher water carrier volume may result in increased disease control. Some anthracnose populations have developed field resistance to the QoI fungicides, so rotation is necessary.



Basal rot anthracnose is especially severe on *Poa annua* and several varieties of creeping bentgrass. Dark black hair-like projections termed setae are produced by the pathogen, (*Colletotrichum cereale*), on leaf blades and sheaths. In the more damaging basal rot phase, crown and stolons also become necrotic and dark black, which can be observed easily by pulling back a few older leaves from the crown.