

The Influence of Turf Management on Turf Diseases

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- MS IN PLANT BIOLOGY FROM UC RIVERSIDE
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The Influence of Turf Management on Turf Diseases



Agenda

- ▶ **Why are turf management practices important to disease development?**
- ▶ **The interaction of turf management practices.**
- ▶ **The ability to influence turfgrass health & vigor.**



Factors Determining Success or Failure

- **Turfgrass Selection**
- **Mowing**
- **Fertilization**
- **Irrigation**
- **Weather Effects**
- **Disease Control**



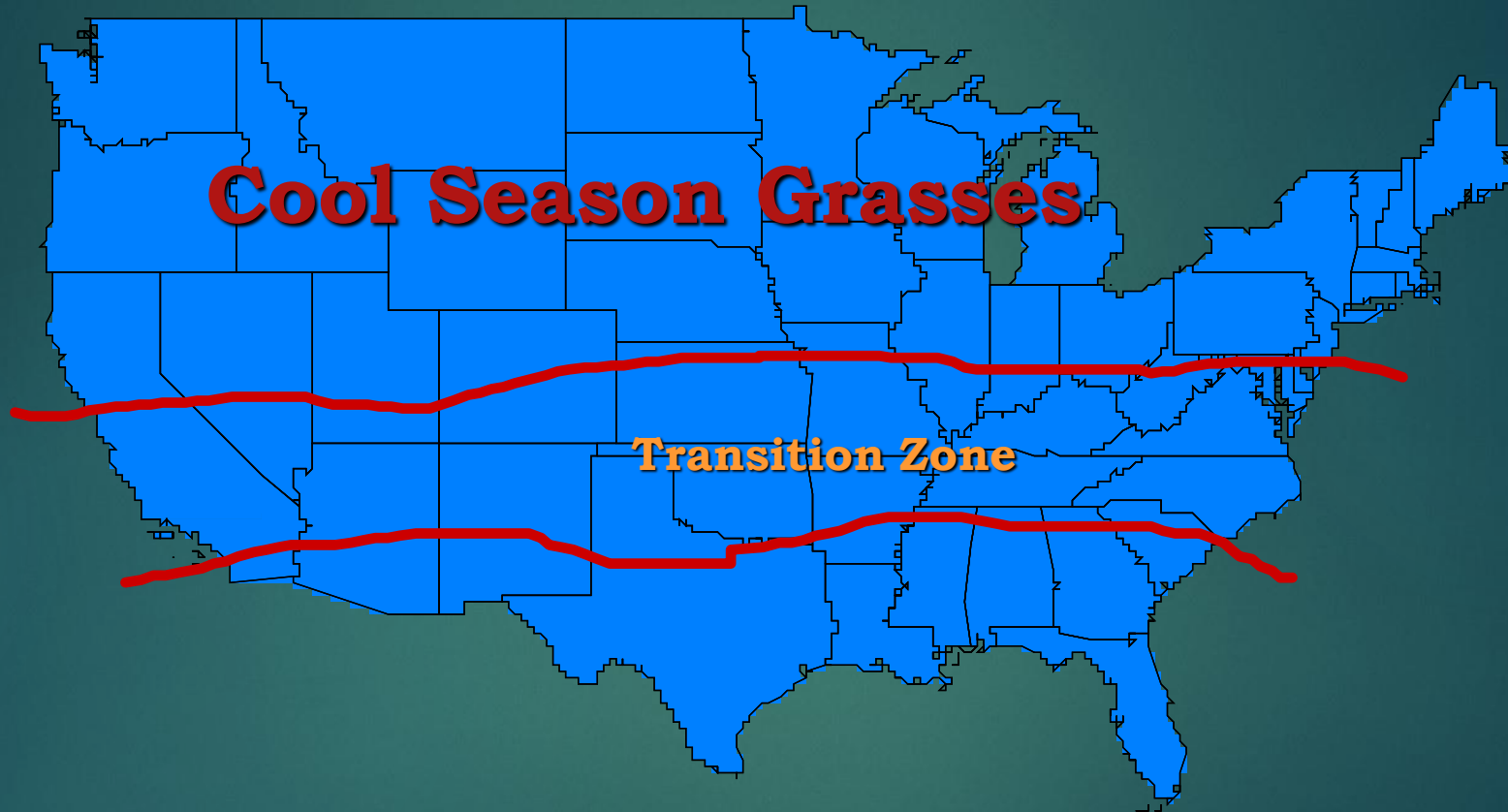
Turfgrass Selection

- **Tolerant to mowing & traffic**
- **Adapted to the site?**
 - ▣ **Winter/summer survivability**
 - ▣ **Shade**
 - ▣ **Moisture requirements**
- **Desired maintenance level**
 - ▣ **Mowing, fertilizer, irrigation**
- **Establishment method**
 - ▣ **Seed, sod, or sprigs**
- **Color and texture**
- **Insect & disease tolerance**



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Turfgrass Adaptation



Warm Season Grasses



Cool Season Turfgrasses

- ▶ **Primarily found in the temperate and subarctic areas.**
- ▶ **Carbon fixation thru the Calvin Cycle (C₃).**
- ▶ **Optimal growth temperatures of 60 to 75°F.**
- ▶ **Long-day plants and flowering requires vernalization.**
- ▶ **Limited by heat & drought stress.**



Cool Season Turfgrasses

- Bentgrasses
- Bluegrasses
- Ryegrasses
- Fine Fescues
- Tall Fescues



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Warm Season Turfgrasses

- ▶ Primarily found in tropical, subtropical and warm temperate areas.
- ▶ Carbon fixation through the Hatch and Slack Pathway (C₄).
- ▶ Optimal growth temperatures of 80 to 95°F.
- ▶ Short day plants with no vernalization for flowering.
- ▶ Limited by cold temperatures.



Warm Season Turfgrasses

- **Bermudagrass**
- **St. Augustinegrass**
- **Bahiagrass**
- **Centipedegrass**
- **Zoysiagrass**



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Maintenance Levels of Northern Turf

Low **Fine Fescues**

Medium **Ryegrasses**
Bluegrasses

High **Bentgrasses**



Maintenance Levels of Transition Zone Turf

Medium

**Tall Fescue
Zoysiagrass**



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Maintenance Levels of Southern Turf

Low

**Bahiagrass
Centipedegrass**

Medium

St. Augustinegrass

High

Bermudagrasses



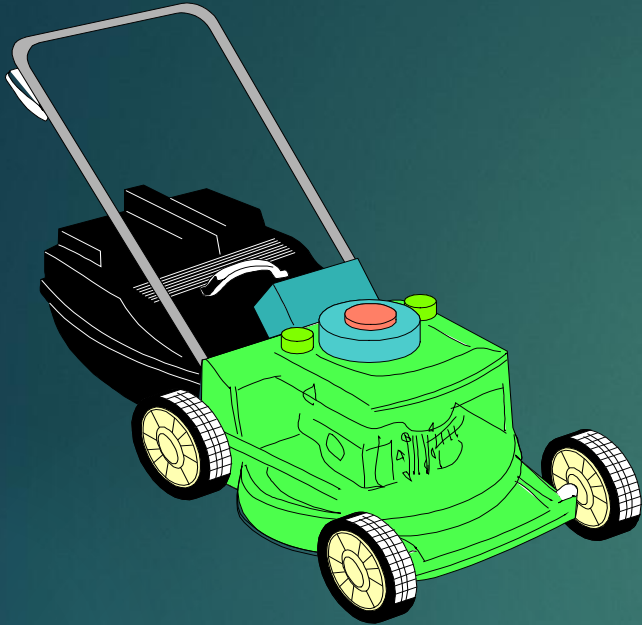
Selection vs. Disease

- ▶ **A healthy and vigorous turf results from:**
 - ▶ Grasses adapted to the site.
 - ▶ Maintained within species requirements.

- ▶ **Diseases develop from physiological stress related problems:**
 - ▶ Wrong site.
 - ▶ Improper management practices.



Mowing



- **THE principle turf management practice.**
- **Frequent mowing encourages dense, low growth habit.**

- ▶ **Each species has an optimal height of cut.**
- ▶ **Mowing frequency is dictated by the turf growth rate.**
- ▶ **Never mow off more than 1/3 of height.**
- ▶ **LOW mowing height stresses the plants !!!**



Mowing Northern Turfgrasses

Turfgrass Species	Typical Height of Cut (Inches)	Frequency of Cut (Days)
Bentgrass		
Greens	<0.25	daily
Fairways	0.25 - 0.75	daily - 7
Fine Fescues	1.5 - 2.5	7 - 14
Kentucky Bluegrass	1.5 - 3.0	7 - 14
Perennial Ryegrass	1.5 - 2.5	7 - 10
Tall Fescue	2 - 3	10 - 14



Mowing Southern Turfgrasses

Turfgrass Species	Typical Height of Cut (Inches)	Frequency of Cut (Days)
Bahiagrass	3 - 4	10 - 14
Bermudagrass		
Greens	<0.25	daily
Fairways	0.5 - 1.5	2 - 3
Athletic Fields	0.75 - 1.5	3 - 7
Home Lawns	0.75 - 1.5	3 - 7
Centipedegrass	2 - 3	10 - 14
St. Augustinegrass	3 - 4	7 - 14
Zoysiagrass	1 - 2	10 - 14



Mowing vs. Disease

- ▶ **A healthy and vigorous turf results from:**
 - ▶ Turf mowed at the correct height.
 - ▶ Frequently mowed turf.

- ▶ **Diseases develop from physiological stress related problems:**
 - ▶ Mowing too low or infrequently.



Fertilization

- ▶ **Key to quality turf.**
- ▶ **17 essential elements.**
- ▶ **Species & cultivar nutritional requirements.**

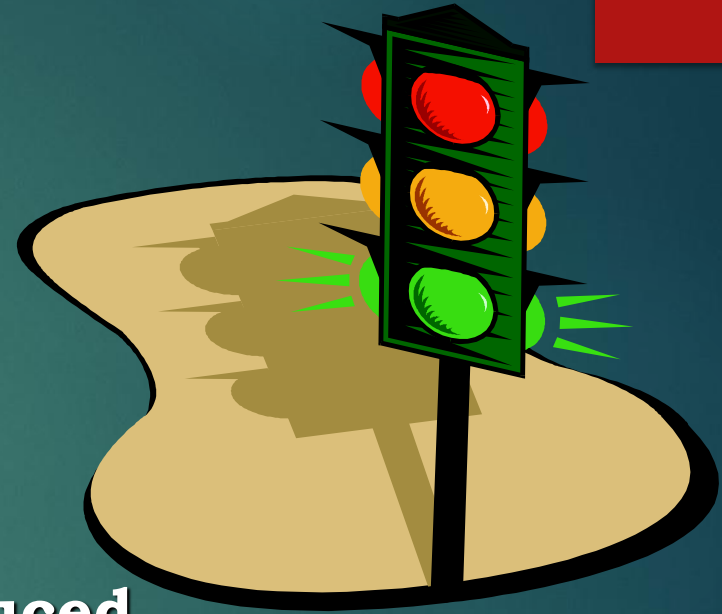
- ▶ **Rate of fertilization varies:**
 - ▶ **Soils**
 - ▶ **Fertilizer form/analysis**
 - ▶ **Irrigation & rainfall**
 - ▶ **Mowing.**



Fertilization

Nitrogen

- ▶ Green color and growth
- ▶ Frequency & timing
- ▶ Excess N - lush tissue with reduced disease tolerance
- ▶ Deficient N - starved tissue with no plant vigor



Fertilizer Requirements for Northern Turfgrasses

Turfgrass Species	Total Pounds of Nitrogen Per 1,000 Square Feet Per Year	Average Number of Fertilizer Applications Per Year
Bentgrass		
Greens	4-8	6-10
Fairways	1-4	2-5
Fine Fescues	2-4	2-4
Kentucky Bluegrass		
Fairways	3-5	4-6
Home Lawns	2-4	2-5
Perennial Ryegrass		
Fairways	3-5	4-6
Home Lawns	3-5	3-5
Overseeded Greens	4-6	5-8
Tall Fescue	2-5	3-4



Fertilizer Requirements for Southern Turfgrasses

Turfgrass Species	Total Pounds of Nitrogen Per 1,000 Square Feet Per Year	Average Number of Fertilizer Applications Per Year
Bahiagrass	2-3	2-4
Bermudagrass		
Greens	8-12	8-14
Fairways	2-5	3-6
Athletic Fields	2-5	3-6
Home Lawns	2-4	3-6
Centipedegrass	2-3	2-3
St. Augustinegrass	4-6	4-8
Zoysiagrass	2-4	3-5



Diseases That Become Severe Under Low Nitrogen Levels

Anthracnose
Cercospora Leaf Spot
Dollar Spot
Red Thread
Rust
Take-All Patch



Diseases That Become Severe Under High Nitrogen Levels

Brown Patch

Copper Spot

Curvularia Blight

Fusarium Patch

Gray Leaf Spot

Gray Snow Mold

Leaf Spot

Melting Out

Necrotic Ring Spot

Pink Snow Mold

Powdery Mildew

Pythium Blight

Stripe Smut

Summer Patch

Yellow Turf

Yellow Patch



Fertilization

▶ Potassium

- ▶ Increases disease and insect tolerance.

▶ Phosphorus

- ▶ Deficiency favors:
 - ▶ Root rot diseases.

▶ Soil pH

- ▶ High alkaline conditions favor:
 - ▶ Take-all patch
 - ▶ Summer patch
 - ▶ Pink snow mold



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Fertilizing vs. Disease

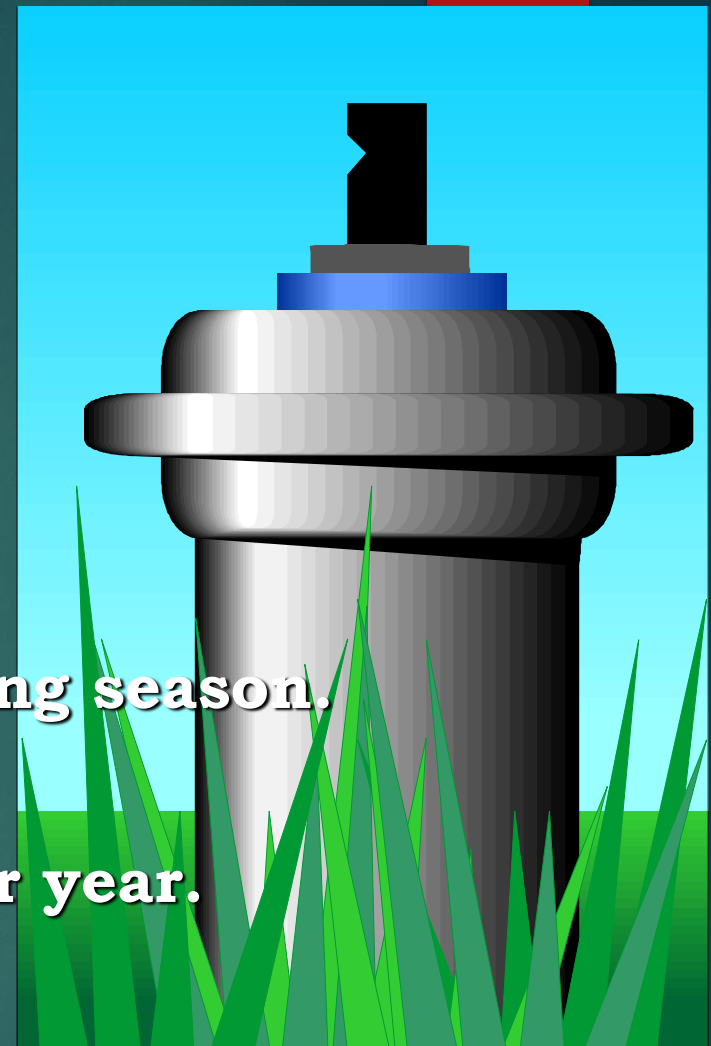
- ▶ **A healthy and vigorous turf results from:**
 - ▶ **Maintained within species fertility requirements.**

- ▶ **Diseases develop from physiological stress related problems.**
 - ▶ **Excess fertility.**
 - ▶ **Improper timing of fertility practices.**



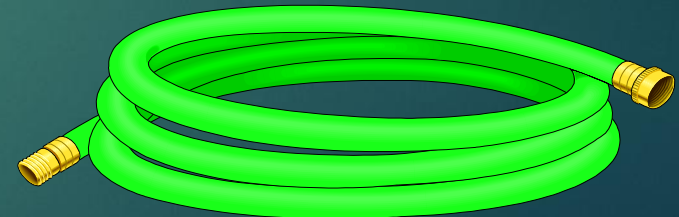
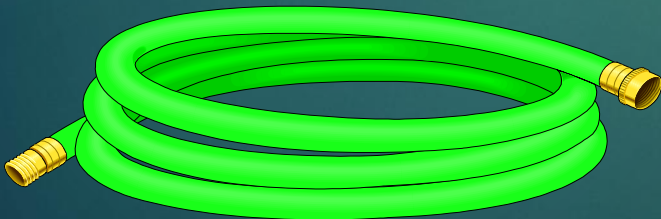
Irrigation

- ▶ Principle turf management practice.
- ▶ Desire for green turf throughout growing season.
- ▶ Turf requires 40-45 inches of water per year.



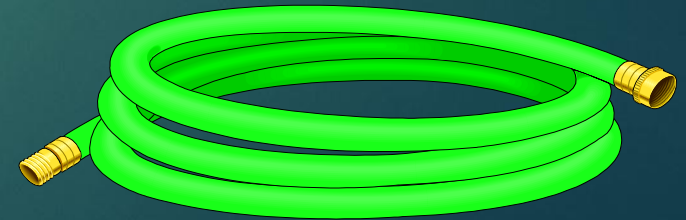
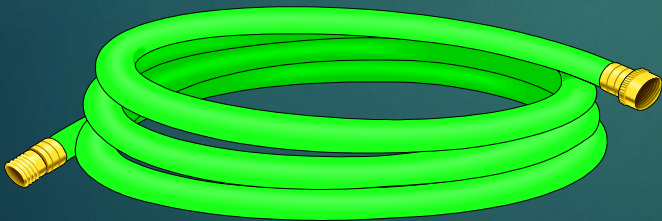
Irrigation

- ▶ **Irrigation applications**
 - ▶ Amount & frequency.
 - ▶ Soil and weather conditions.
- ▶ **Night irrigation**
 - ▶ Naturally wet period (dew).
 - ▶ Best 4 to 6 am.



Irrigation

- ▶ **Deficient moisture**
 - ▶ Localized dry spots
 - ▶ Brown dormant grass
- ▶ **Excessive moisture**
 - ▶ Favorable disease conditions
- ▶ **Periodic wetting & drying**
 - ▶ Favorable for sporulation.



Irrigation vs. Disease

- ▶ **A healthy and vigorous turf results from:**
 - ▶ Grasses adapted to the site.
 - ▶ Maintained within species requirements.

- ▶ **Diseases develop from:**
 - ▶ Moisture conditions favorable for diseases.
 - ▶ Improper management practices.



Weather Conditions for Turf Diseases

- **Cold & Wet** **Snow Molds**
- **Cool & Wet** **Red Thread**
Take-All Patch
Cool Weather Brown Patch
- **Cool & Dry** **Rust**
Stripe Smut



Weather Conditions for Turf Diseases

• **Warm & Wet**

Anthracnose

Dollar Spot

Gray Leaf Spot

Leaf Spot

• **Warm & Dry** **Necrotic Ring Spot**

• **Hot & Wet**

Brown Patch

Pythium

Summer Patch



Fungicide Resistance Action Committee (FRAC) Codes

FUNGICIDES MODE OF ACTION TABLE

FRAC GROUP	MODE OF ACTION	CHEMICAL FAMILY (GROUP)	ACTIVE INGREDIENTS
1	Mitosis and cell division	benzimidazoles	thiabendazole
1		thiophanates	thiophanate-methyl
2	Respiration		iprodione vinclozolin
3	Sterol synthesis	imidazoles	Imazilil
3		piperazines	Triforine
3		pyrimidines	Fenarimol
3		triazoles	bifertanol cyproconazole difenoconazole fenbuconazole flusilazole ipconazole metconazole myclobutanil propiconazole prothioconazole tebuconazole tetraconazole triadimenol triadimenol triticonazole
4	Nucleic acid synthesis	acylalanines	metalaxyl metalaxyl-M (=mefenoxam)
7	Respiration		boscalid carboxin flutolanil
9	Protein synthesis		cyprodinil
11	Respiration	methoxyacrylates	azoxystrobin picoxystrobin
11		methoxy-carbamates	pyraclostrobin
11		oximino acetates	kresoxim-methyl trifloxystrobin
11		oxazolidine-diones	famoxadone
11		dihydro-dioxazines	fluoxastrobin
11		imidazolinones	fenamidone
12	Signaling		fludioxonil
13	Signaling		quinoxifen
14	Lipids and membranes		chloroneb dicloran quintozene (PCNB) etridiazole
14		1,2,4-thiadiazoles	
17	Sterol synthesis		fenhexamid

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FUNGICIDES MODE OF ACTION TABLE

FRAC GROUP	MODE OF ACTION	CHEMICAL FAMILY (GROUP)	ACTIVE INGREDIENTS
19	Cell wall synthesis	peptidyl pyrimidine nucleoside	polyoxin
21	Respiration	cyanoimidazole	cyazofamid
22	Cell division		zoxamide
24	Protein synthesis		kasugamycin
25	Protein synthesis		streptomycin
27	Unkown		cymoxanil
28	Cell membrane permeability		propanoic acid
29	Respiration	2,6-dinitro-anilines	fluazinam
30	Respiration	tri phenyl tin compounds	fentin hydroxide
33	Unkown	ethyl phosphonates	fosetyl-Al
33			phosphorous acid and salts
40	Cell wall synthesis	cinnamic acid amides	dimethomorph
40		mandelic acid amides	mandipropamid
41	Protein synthesis		oxytetracycline
P	Host plant defense induction	benzo-thiadiazole BTH	acibenzolar-S-methyl
M	Multi-site contact activity	inorganic	copper sulphur
		dithiocarbamates and relatives	ferbam mancozeb mactram thiram ziram
		phthalimides	captan
		chloronitriles (phthalonitriles)	chlorothalonil
		guanidines	dodine
NC	Not classified	diverse	mineral oils, organic oils, potassium bicarbonate

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Thiophanates

- ▶ Cleary's 3336
- ▶ Broad spectrum
- ▶ Systemic activity
- ▶ Moderate to very high resistance risk
- ▶ FRAC Code: 1



Dicarboximides

- ▶ Chipco 26GT, Chipco 26019
- ▶ Moderate spectrum of activity
- ▶ Contact with some locally systemic activity
- ▶ High resistance risk
- ▶ FRAC Code: 2



Sterol Inhibitors (Triazoles, DMI's)

- ▶ Bayleton, Banner MAXX, Tourney, Eagle, etc.
- ▶ Broad spectrum, excellent activity
- ▶ Moderate resistance risk
- ▶ Systemic activity
- ▶ FRAC Code: 3



Ethyl phosphonates

- ▶ Chipco Signature, Appear II
- ▶ Narrow spectrum; *Pythium*
- ▶ True systemic (phloem and xylem mobile)
- ▶ Low to moderate resistance risk
- ▶ FRAC Code: 33



Acylalanines

- ▶ Subdue Maxx (mefenoxam)
 - Narrow spectrum, specific for oomycetes (downy mildew and *Pythium*)
 - Systemic activity
 - High resistance risk
 - FRAC Code: 4



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Dithiocarbamantes (EBDC's)

- ▶ Dithane, Fore (mancozeb)
 - Broad spectrum
 - Contact activity
 - Low resistance risk
 - FRAC Code: M03



Chloronitriles

- ▶ Daconil (chlorothalonil)
 - Broad spectrum
 - Contact activity
 - Low resistance risk
 - FRAC Code: M05



Succinate Dehydrogenase Inhibitors (SDHI's)

- ▶ Prostar, Xzemplar, Velista
- ▶ Narrow spectrum
- ▶ Low resistance risk because of pathogens
- ▶ Contact activity
- ▶ FRAC Code: 7



Strobilurins/QOI Inhibitors

- ▶ Compass, Heritage, Insignia
- ▶ Broad spectrum
- ▶ Systemic activity
- ▶ Moderate resistance risk
- ▶ FRAC Code: 11



Phenylpyrroles

▶ Medallion (Fludioxonil)

- Broad spectrum
- Contact activity
- Low resistance risk
- FRAC Code: 12



Peptidyl pyrimidine nucleoside

- ▶ Affirm (Polyoxin D zinc salt)
- ▶ Broad spectrum
- ▶ Contact with locally systemic activity
- ▶ Unique mode of action
- ▶ FRAC Code: 19



Cyanoimidazole

- ▶ Segway (cyazofamid)
- ▶ Narrow spectrum; Pythium spp.
- ▶ FRAC Code: 21



2,6-dinitro-anilines

- ▶ Secure Action (fluazinam)
- ▶ Broad spectrum
- ▶ Contact activity
- ▶ FRAC Code: 29



Mineral Oils

- ▶ Civitas
- ▶ Broad spectrum (national label)
- ▶ Induces acquired systemic response
- ▶ Unique mode of action
- ▶ OMRI certified
- ▶ FRAC Code: NC



Fungicide Resistance Management

- ▶ Rotate in blocks: Fungicide FRAC “X” applied 2-3 times and rotated to Fungicide FRAC “Y” applied 2-3 times.
- ▶ Mixtures (pre-mix or tank-mix) should only be used to manage multiple diseases/pathogens at labeled rates.
- ▶ DO NOT USE LOW OR BELOW LABELED RATES OF PRODUCTS EVEN IN MIXTURES!
- ▶ Check label for annual maximums



Other Things To Consider

- ▶ Soil Testing – Is everything balanced? Should I apply gypsum and/or lime?
- ▶ Slopes – Are you overwatering the slope resulting in saturated low areas?
- ▶ Soil Surfactants – Can I use to save water and not overwater?
- ▶ Shade – Am I overwatering because of shade?



Future Trends

- ▶ Increasing use of organic fertilizers – Easier to balance soils and better in poor water quality situations
- ▶ Use of more heat/drought tolerant turf – Bermuda's, Zoysia, Fescues and even some new perennial ryegrasses
- ▶ Increasing use of slow release fertilizers – 100% slow release products allow for significant labor savings and turf performance
- ▶ Increasing use of wetting agents – Savings all around in water, labor and other inputs
- ▶ Increased use of newer products/technology – Silica products, ASR/ISR type products, irrigation sensors



Conclusions

- **Turfgrass Selection**
- **Mowing**
- **Fertilization**
- **Irrigation**
- **Weather Effects**
- **Disease Control**
- **Healthy Soils/Healthy Turf**



Questions?

ANY LAST WORDS??



Thank you!

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