Disease Management for Turfgrasses

Bruce Martin, Ph.D.
Clemson University

UPDATE ON NEW FUNGICIDES FOR TURFGRASS DISEASE CONTROL

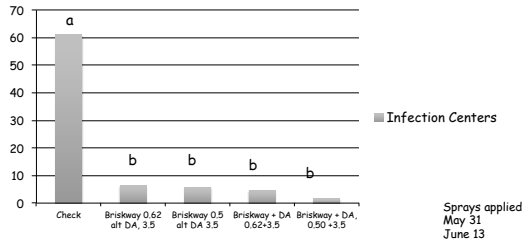
Fungicide Chemical Families

- Aromatic Hydrocarbons - ethazole, PCNB, chloroneb
- Benzimidazoles - benomyl, thiophanate methyl
- Carboxamides - flutolanil, carboxin, oxycarboxin, boscalid, penthiopyrad, fluxapyroxad
- Demethylation Inhibitors (DMI) Fungicides – difenoconazole, triadimefon, propiconazole, cyproconazole, myclobutanil, tebuconazole, triticonazole, metconazole, fenarimol
- Dicarboximides - iprodione, vinclozolin
- Dithiocarbamates and carbamates- captan, maneb, mancozeb, propamocarb, thiram
- Nitriles - chlorothalonil
- Phenylamides - metalaxyl, mefanoxam
- Phenyl pyridinamine - fluazinam
- Phenylpyrrole - Medallion
- Phosphonates - fosetyl Al, generic phosphite fungicides
- Strobilurins (Qoi, methoxyacrylates)- azoxystrobin, trifloxystrobin, pyraclostrobin, fluoxastrobin…
- Qii – cyazofamid (Segway) – now PBI Gordon
- Carboxilic acid amide - fluopicolide (with propamocarb in Stellar)
- Benzothiadiazole – acibenzolar-S-methyl (Daconil Action)

New Syngenta Fungicides

- "Appear" – 53.3% potassium phosphite; a 4.1 lb/ gal formulation – 3-8 fl oz/1000 sq.ft.; Pythium diseases –
- "Secure" – 40% fluazinam as a 4.17 lb/gal FRAC group 29; 0.5 fl oz/1000 sq.ft. broad spectrum – *golf courses only*
- "Briskway" – 1.67 lb azoxystrobin + 1.05 lb difenoconazole/gal = 2.72 lb/gal broad spectrum premixture (rates 0.3-0.73 fl oz/1000 sq.ft.) – *golf course turf only*

Curative Control of Dollar Spot in Crenshaw Bent 2012



Sprays applied
May 31
June 13
June 27
July 11

New Fungicides – SDHI mode of Action

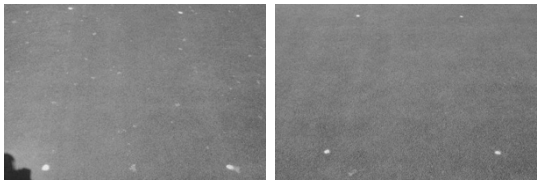
- SDHI = succinate dehydrogenase inhibitors. "Carboxamide" class
- Subgroupings are:
  - phenyl-benzamides (e.g. flutolanil)
  - phenyl- carboxamides (e.g. boscalid)
  - pyrazole-carboxamides (2 new ones)

SDHI Fungicides – FRAC code 7, medium resistance risk

- penthiopyrad – "Velista" from DuPont, now being developed by Syngenta, marketing anticipated 2015
- fluxapyroxad – "Xzemplar" from BASF (tested as BAS 700) – *full use sites*
- BASF has developed a pre-mix of fluxapyroxad + pyraclostrobin (BAS 703) called "Lexicon" – *full use sites*

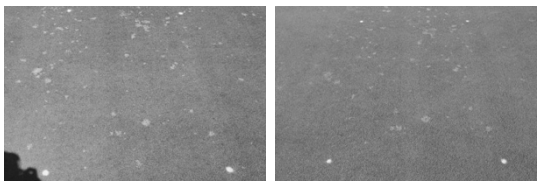
Xzemplar 0.262 oz/M

May 30 June 13

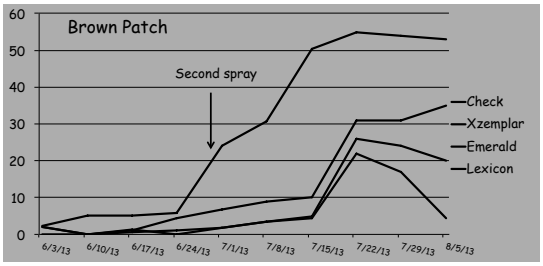


Velista, 0.5 oz/M

May 30 June 13

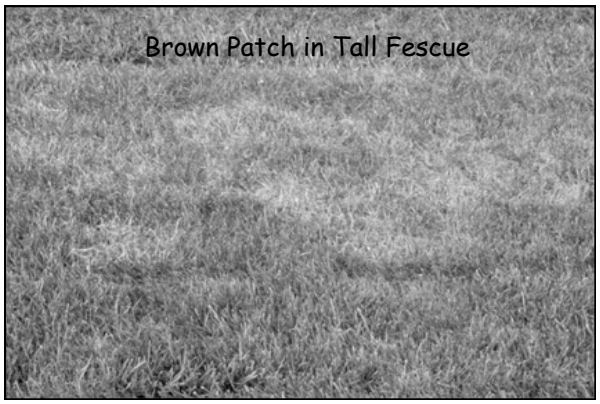


Xzemplar and Lexicon for Dollar Spot and Brown Patch – Residual Control



Know the Key Diseases on the Grass in Question -

- Centipedegrass - large patch, nematode infestations, fairy ring, 'centipede decline'
- St. Augustinegrass – large patch, gray leaf spot, take-all root rot
- Zoysiagrass – large patch, dollar spot, yellow patch, leaf spots
- Bermudagrass - dollar spot, spring dead spot, leaf spots
- Tall fescue – brown patch, Pythium blight, gray leaf spot, net blotch



Brown Patch in Cool-season Turfgrasses - Management

- **balanced fertility at pH optimum for the grass itself (based on soil test)**
- **improve air movement, sunlight penetration**
- **decrease leaf wetness by irrigation adjustments**
- **correct subsurface drainage problems if they exist**
- **avoid high N fertility during periods of heat stress**
- **improved cultivars for heat stress areas**
- **use of fungicides**

Brown Patch in Cool-season Turfgrasses - fungicides

- triadimefon - Bayleton
- propiconazole – Banner
- myclobutanil - Eagle
- vinclozolin - Curalan, etc
- iprodione - Chipco 26019
- thiophanate methyl - Cleary 3336 (only G formulation can be used by homeowners)
- fluoxastrobin – DisArm, DisArm G, DisArm C
- Fluxapyroxad – Xzemplar
- Penthiopyrad – Velista
- Fluazinam - Secure
- chlorothalonil – Daconil, etc.
- flutolanil – Prostar, Systar
- mancozeb - Fore, Dithane
- azoxystrobin – Heritage, Heritage G, Headway, Briskway, Strobe
- trifloxystrobin – Compass
- trifloxystrobin + triadimefon – Armada, Tartan
- Pyraclostrobin – Insignia
- Pyraclostrobin + boscalid - Honor
- Pyraclostrobin + fluxapyroxad - Lexicon

Pythium Blight Control

- ✓ Maintain soil moisture in adequate range for plant growth and soil pH in a more acid range; balanced adequate fertility
- ✓ Reduce leaf wetness by late night irrigations
- ✓ Use of fungicides:

* Subdue Maxx	* Insignia
* Banol (sod, golf onl	* DisArm
* Phosphites	* Segway
* Heritage	* Stellar

Note: mixtures of strobilurins also registered for Pythium although use sites vary.

Large Patch

- ✦ St. Augustinegrass
- ✦ Zoysiagrass
- ✦ Centipedegrass
- ✦ Bermudagrass

Most susceptible

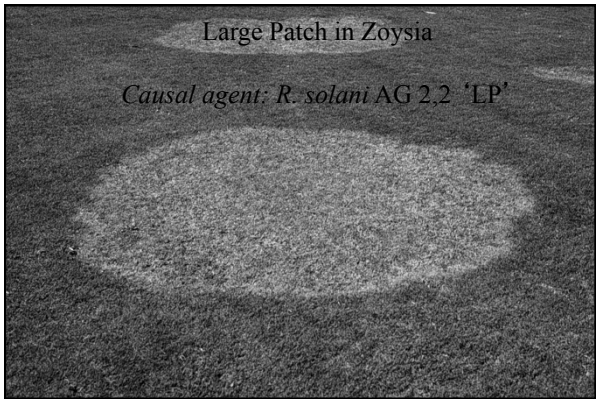
↕

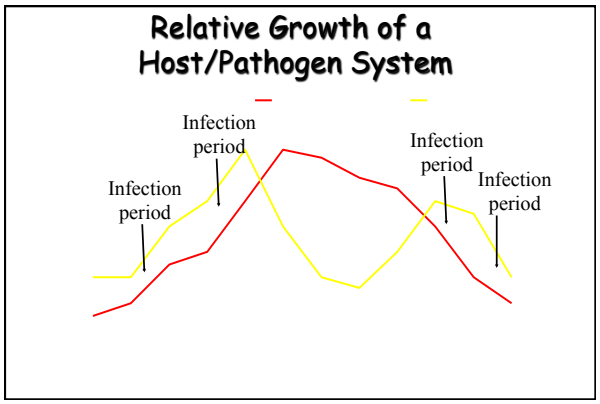
Least susceptible

Sheath Rot Symptom of brown patch (Large Patch) in St. Augustine

***R. solani* AG 2,2 "LP"**

Infections occur in the lower basal leaf sheath area, not on leaf lamina


Large Patch in Zoysia
Causal agent: R. solani AG 2,2 'LP'


Relative Growth of a Host/Pathogen System
Infection period
Infection period
Infection period
Infection period

Large Patch (Brown Patch) of Warm-season Turfgrasses - Management

- ✓ provide good surface and subsurface soil drainage
- ✓ alter irrigation to limit leaf and thatch moisture
- ✓ balanced N fertility, avoid excess N in late summer/early fall
- ✓ fungicide applications:
  - apply in fall before initial outbreak, repeat in severe cases after 28-30 days
  - a single application to follow up in spring as grasses come out of dormancy may also improve control
  - Prostar, Heritage, Insignia are very good fungicides for this disease; other fungicides may provide good control

Fungicides Labeled for Large Patch

- Heritage (Azoxystrobin)
- Insignia (pyraclostrobin)
- DisArm (fluoxastrobin)
- Daconil,,,(chlorothalonil)
- Prostar (flutolanil)
- Terremec SP (chloroneb)
- 26 GT,,, (iprodione) *not home lawns
- Bayleton (triadimefon) (supp. label req'd for home lawns)
- Secure (fluazinam) – GC only
- Xzemplar (fluxapyroxad)
- Banner (propiconazole)
- Eagle (myclobutanil)
- Tourney (metconazole)
- Trinity (triticonazole)
- Affirm (polyoxin)
- Cleary 3336,,, (thiophanate methyl) (not home lawns except G formulation)

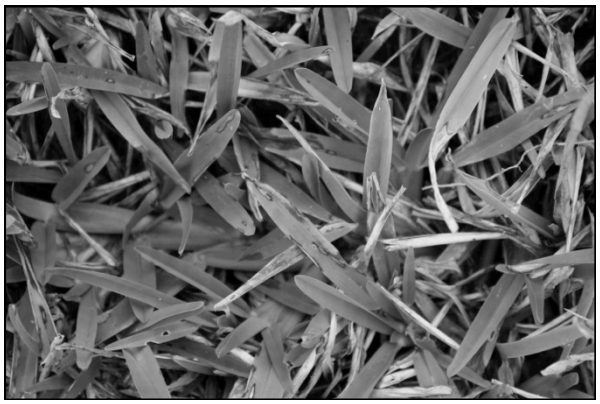
Granular formulations of Heritage, Insignia, Disarm are available

Fungicides Labeled for Large Patch - Combinations

- ✦ Headway (azoxystrobin + propiconazole) – 1.5-3 fl oz
- ✦ Briskway (azoxystrobin +difenoconazole) – 0.3- 0.725 oz
- ✦ DisArm C (chlorothalonil + fluoxastrobin) – 3 to 6 fl oz
- ✦ DisArm M (chlorothalonil + myclobutanil) -
- ✦ Consyst 67WDG (chlorothalonil + thiophanate methyl) – 2 to 8 oz *** others available
- ✦ 26/36 3.8F – Iprodione + thiophanate methyl –2 to 4 fl oz **not home lawns
- ✦ Systar 80WG (thiophanate methyl + flutolanil) – 2 to 3 oz **not home lawns
- ✦ Honor 28WG – (boscalid + pyraclostrobin) – 1.11 oz
- ✦ Lexicon (fluxapyroxad + pyraclostrobin) – 0.34 oz
- ✦ Pillar G (triticonazole + pyraclostrobin) – 3 lb/1000 sq.ft.

Gray Leaf Spot

- Pathogen: *Pyricularia grisea*
- Hosts: St. Augustinegrass, tall fescue, ryegrasses, some weedy grasses (e.g. crabgrass).
- Disease Profile: A very common disease in St. Augustine wherever it is grown. The disease occurs in very hot, humid weather and is generally more severe in newly established lawns, in shady locations or locations with poor air movement.



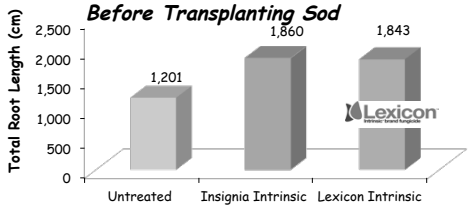
Gray Leaf Spot

- *Cultural control*: improve air movement and light penetration in areas prone to chronic infections. Irrigate in very early morning to promote maximum drying conditions during the day. Avoid excessive rates of nitrogen fertilizers. Mow on a suggested schedule appropriate to growth rate of the turf.

Fungicides for Gray Leaf Spot- rates/1000 sq.ft.

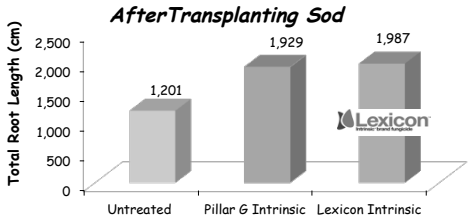
- Armada 50WP – 0.6 to 1.2 oz, 14-28 day
- Briskway 2.72 SC- 0.3-0.725 (no more than 2 seq. apps) GC only
- Heritage 50WDG - 0.2 to 0.4 oz, 14-28 day
- Headway – 1.5-3 fl oz, 14-28 day
- Compass 50WDG - 0.15 to 0.25 oz, 14-21 day
- Insignia 20WDG – 0.5-0.9 oz/14-28 day
- Honor – 0.5-1.1 oz/14-28 day (GC only)
- Lexicon – 0.34-0.47 oz/14-28 day
- Pillar G (triticonazole + pyraclostrobin) – 3 lb/1000 sq.ft./14-28 day
- Mancozeb formulations - see labels for rates
- Banner Maxx - 1 to 2 fl oz, 14 day
- Tourney – 0.37 oz, 14 day
- Endorse – 4 oz/14 day
- thiophanate methyl formulations (Cleary 3336, Fungo, Cavalier)- 4 to 8 fl oz
- combinations of chlorothalonil + thiophanate methyl (e.g. Spectro 90, Consyst)

St. Augustingrass Root Growth Increases with Lexicon and Insignia Intrinsic brand fungicides

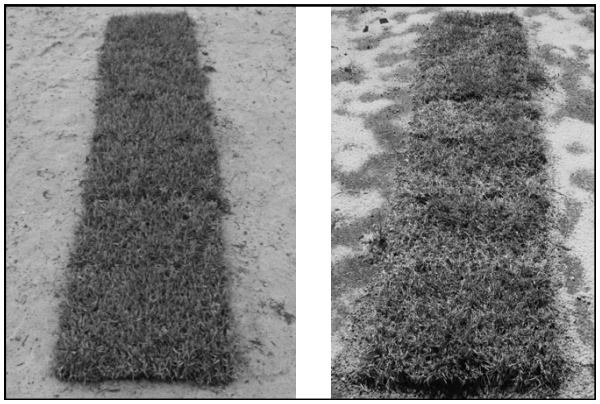


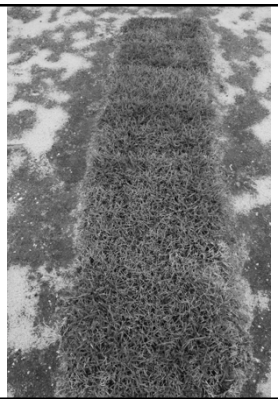
Application made 14-days prior to cutting sod for transplanting. Roots cores were taken 4 months after treatment. Treatments are statistically different from untreated. Dr. Bruce Martin, Clemson University, 2012.

St. Augustingrass Root Growth Increases with Pillar and Lexicon Intrinsic brand fungicides



Application made after sod was transplanted. Root cores taken 4 months after treatment. Treatments are statistically different from untreated. Dr. Bruce Martin, Clemson University, 2012.





Spring Dead Spot

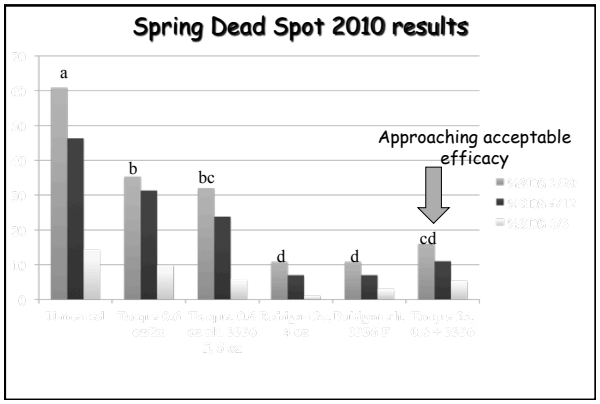
- Causal Agent(s): *Ophiosphaerella herpotricha*, *O. korrae* and *O. narmari*
- Hosts: bermudagrass, bermudagrass hybrids, zoysia (rare) and buffalograss
- Symptoms generally present
  - Early-Spring
  - Concurrent with breaking dormancy

Cultural Practices to Reduce Spring Dead Spot Disease Severity

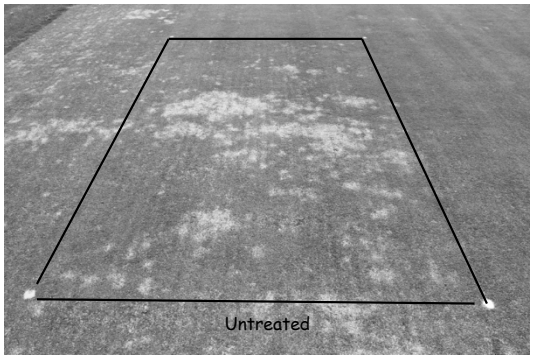
- Plant root rhizosphere acidification,ammonium (NH_4) based N-Sources (ex. $(NH_4)_2SO_4$ or NH_4Cl) 1.0 lb N /M per growing month
- Monitor soil nutrient status, especially Potassium, (KCl) 1.0 lb K / M per growing month
- Core Aerification and Verticutting
- More SDS tolerant varieties (ex. Patriot, Midlawn, Vamont)

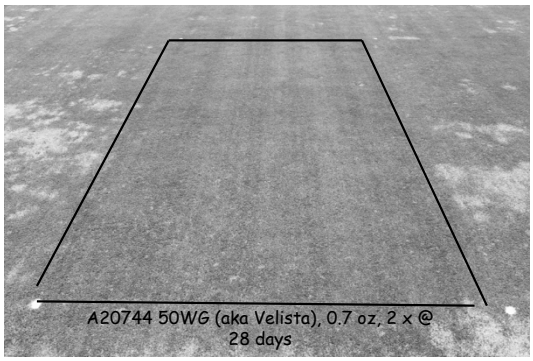
Spring Dead Spot Management with Fungicides

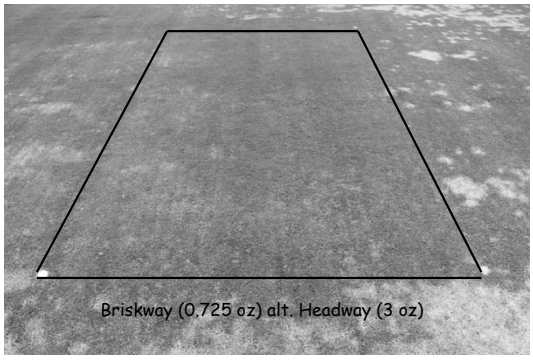
Products Labeled	Rate (oz/1,000 ft^2)	Notes
Rubigan 1A.S. (no longer available)	4.0 to 6.0 fl. oz	1 apps at 4 oz or 1 app at 6 oz
Banner Maxx 1.24MC	4.0 fl. oz	1 to 3 apps. beginning in August
Torque 3.6 SC	0.6 fl oz	28 day interval; 68 F in fall and spring
Heritage 50WG TL formulation	0.4 oz or 2 fl oz	1 to 2 apps. beginning in late-Fall
Eagle 20 EW	2.4 fl oz	1 to 2 apps. beginning in August
Cleary 3336	4-6 oz	Fall and spring applications
DisArm 480SC DisArm 0.25G	0.36 fl oz 2.3-4.6 lb	1-2 applications/ 28 days apart

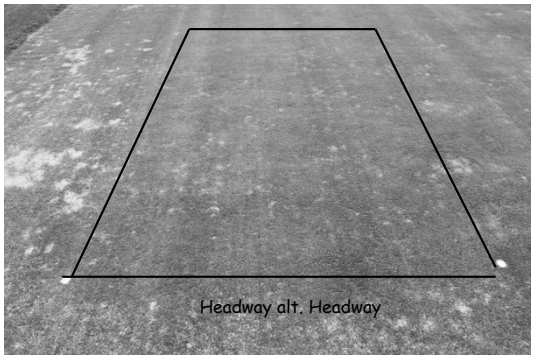


SPRING DEAD SPOT TRIAL 2014 – TIFEAGLE BERMUDAGRASS



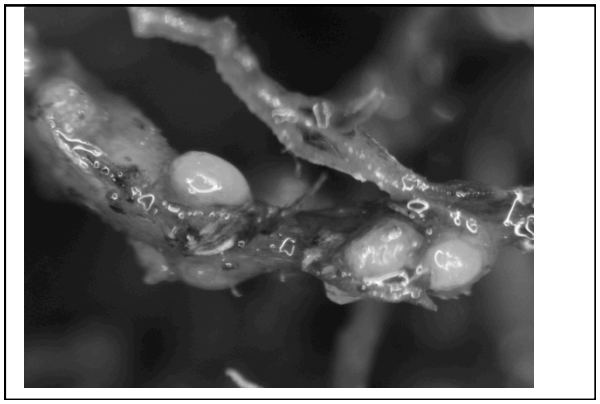

A20744 50WG (aka Velista), 0.7 oz, 2 x @ 28 days

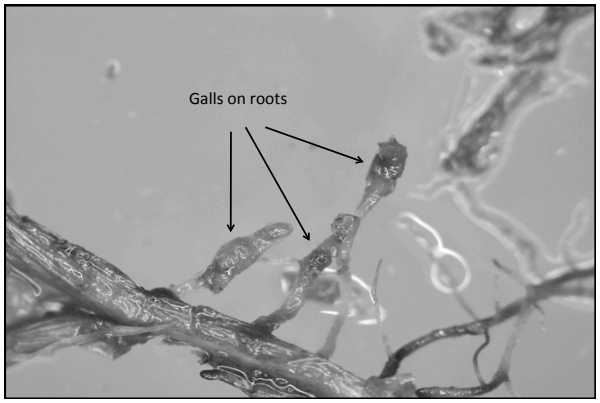

Briskway (0.725 oz) alt. Headway (3 oz)


Headway alt. Headway

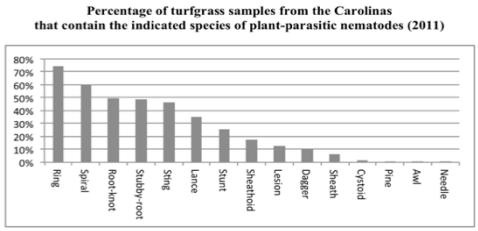
Ring (*Criconemella*) nematode damage
in a centipedegrass lawn

Yellow bermudagrass damaged from
Sting nematodes (*Belonolaimus longicaudatus*)




Galls on roots


Galls on each root tip, now necrotic



Survey of Plant-parasitic Nematodes in Carolina Turfgrass

by Weimin Ye[1], Yongsan Zeng[2], Lane Tredway[2], Samuel Martin[3] and Matt Martin[2]

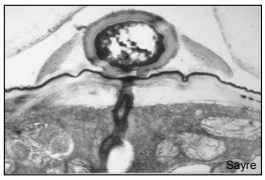
Biological and 'biorational' nematicides

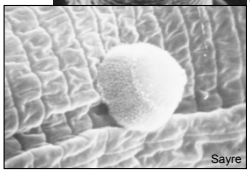
- Ditera (a fungus, *Myrothecium roseum*) – 20 lb/A application rate
- Sesame extracts (e.g. Neo-Tec)
- Neem extracts (Agroneem EC; azadirachtin)
- Mustard plant by-products (glucosinolate metabolites are nematicidal)
- *Pasteuria penetrans* , *P. busae*
- Avid 0.15 EC (abamectin)
- Others: chitin and chitosan products, thyme oil, 'biosafe nematicide: peroxyacetic acid; VA mycorrhizae

BACTERIA

- ***Pasteuria penetrans, P. usgae***


Kerry


Sayre


Sayre

Bacillus firmus – Nortica (Bayer)

"BioNem WP is effective against phytopathogenic nematodes, and is registered in Israel for the control of root knot nematodes in vegetable crops (cucumber, tomatoes, pepper, eggplant and herbs) and in perennial crops (peaches, olives, ornamentals). Long term suppression of nematode population was observed following single application of BioNem WP, either pre or post-planting."

Rooting data, July 22

Treatments	Rate (lb/A)	Timing	Depth of Rooting	Root biomass (g)
1. Untreated			15.79 ab	0.136362522 c
2. Nortica 5%WP	35	April 19, May 14	16.95 a	0.204887515 a
3. Nortica 5%WP	70	April 30	14.65 ab	0.179612506 abc
4. Nortica 5%WP	35	April 30, May 28	16.28 a	0.140212520 bc
5. Nortica 5%WP	17.5	Apr. 19, Apr. 30, May 14, May 28	14.03 ab	0.160475017 abc
6. Nemacur 10G	2.3 lb/1000 sq.ft.	April 19	16.38 a	0.173775020 abc
7. Nortica 5%WP	35	May 14, June 18	16.73 a	0.200512519 ab
8. Nortica 5% WP	70	June 18	11.10 b	0.160175012 abc

Multiguard Protect EC datapak 29499 Multiguard Protect datapak 1/4/2011 9:53 AM Page 1

MULTIGUARD PROTECT

For terrestrial (outdoor) non-food use on established turf on golf course tees and greens, practice greens and fairlined farms; when used as directed, MULTIGUARD PROTECT® EC controls root infesting plant parasitic nematodes, and fungal plant diseases such as species of Pythium, Phytophthora, Fusarium and Rhizoctonia.

Active Ingredient	(by weight)
Furfural	90.0%
Other Ingredients	10.0%
TOTAL	100.0%

1 gallon of MULTIGUARD PROTECT® EC contains 8.68 lbs furfural
1 gallon of MULTIGUARD PROTECT® EC weighs 9.65 lbs at 68oF

KEEP OUT OF REACH OF CHILDREN
WARNING – AVISO

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

FIRST AID

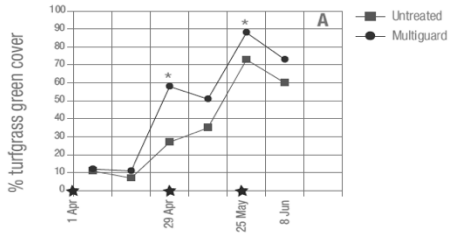
If on Skin or Clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a poison control center or doctor for treatment advice.
If in Eyes	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a poison control center or doctor for treatment advice.
If Swallowed	• Call a poison control center or doctor immediately for treatment advice. • Have person sip a glass of water if able to swallow. • Do not induce vomiting unless told to do so by the poison control center or doctor. • Do not give anything by mouth to an unconscious person.
If Inhaled	• Move person to fresh air. • If person is not breathing, call 911 or ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible. • Call a poison control center or doctor for further treatment advice.

HOTLINE NUMBER CHEMTREC 1-800-424-9300 (24 hours)
Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-222-1222 for emergency medical treatment information.
NOTE TO PHYSICIAN Probable mucosal damage may contraindicate the use of gastric lavage.

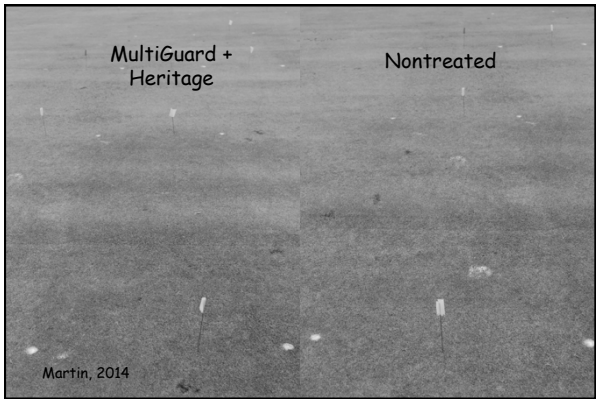
SEE SIDE PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS
Manufactured for Agriguard Company, LLC
Centennial Plaza, Suite 160, 190 North Avenue East, Cranford, NJ 07016
EPA Establishment No. 75753 **EPA Registration No. 75753-1**
Producing establishment No. 484-56-TX-01
Net Contents: _____ gal.

29499

Spring Applications of MultiGuard Protect to Bermudagrass Greens



Crow, GCM July 2014



(Fluensulfone) MCW-2 480 EC; A new systemic,

non-fumigant nematicide for the control of nematodes in Agricultural and Horticultural crops.

C.T. Schiller, R.C. Everich & J.R. Whitehead
Makhteshim Agan of North America (MANA)

To be labeled in turf as 'Nimitz' in 2016 anticipated

FIERA

Section 24(c) Special Local Need Label

FOR DISTRIBUTION AND USE ONLY WITHIN THE STATE OF SOUTH CAROLINA

AVID® 0.15EC MITICIDE/INSECTICIDE

EPA Reg. No. 100-896

EPA SLN NO. SC-110003

For Nematode Control on Golf Course Greens Only

KEEP OUT OF REACH OF CHILDREN

WARNING/AVISO

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

Environmental Hazards

This pesticide is toxic to fish and wildlife.

For terrestrial uses: do not apply directly to water, to areas where surface water is present, or to intertidal areas below the mean high water mark. Do not apply when weather conditions favor drift from target areas. Do not contaminate water when disposing of equipment wash water or rinsate. This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area. Use of this product may pose a risk to threatened and endangered species of fish, amphibians, crustaceans (including fresh water shrimp), and insects.

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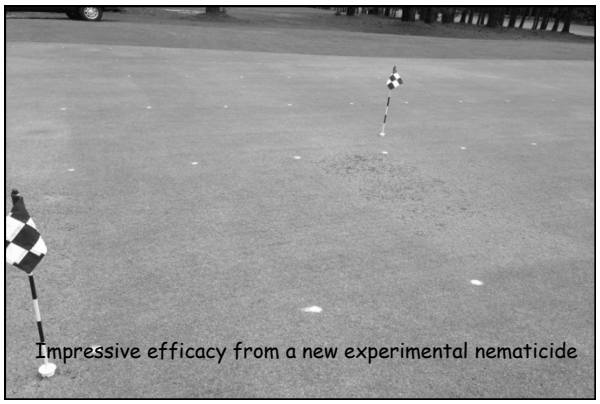
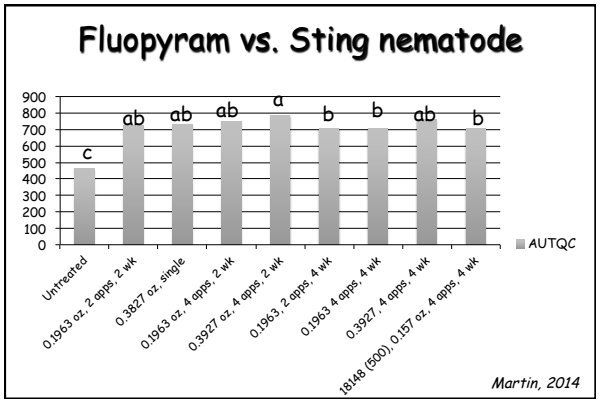
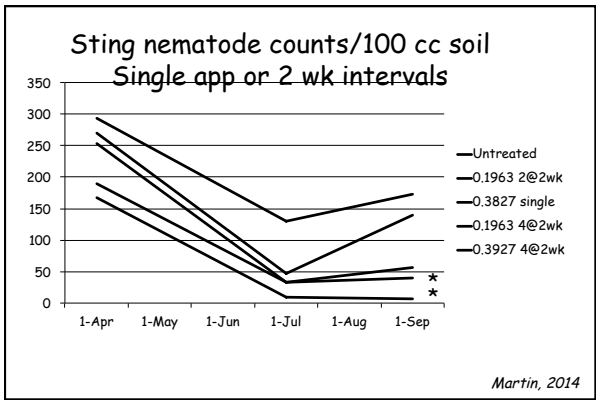
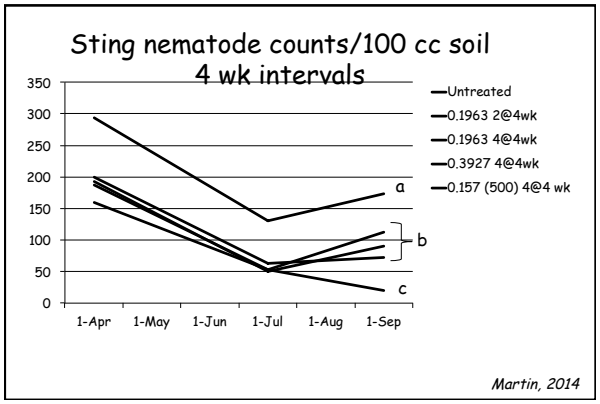
24 C label to be replaced by a full Federal label and allow greens, tees and fairways.
Multiple applications also allowed vs the higher 24 C label rates and intervals




Martin, 2014


Fluopyram vs. Sting nematode
900
800
700
600
500
400
300
200
100
0
c
ab
ab
ab
a
b
b
ab
b
AUTQC
Untreated
0.1963 oz, 2 apps, 2 wk
0.3827 oz, single
0.1963 oz, 4 apps, 2 wk
0.3927 oz, 4 apps, 2 wk
0.1963, 2 apps, 4 wk
0.1963 4 apps, 4 wk
0.3927, 4 apps, 4 wk
18148 (500), 0.157 oz, 4 apps, 4 wk
Martin, 2014


Sting nematode counts/100 cc soil
Single app or 2 wk intervals
350
300
250
200
150
100
50
0
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
Untreated
0.1963 2@2wk
0.3827 single
0.1963 4@2wk
0.3927 4@2wk
*
*
Martin, 2014


Sting nematode counts/100 cc soil
4 wk intervals
350
300
250
200
150
100
50
0
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
Untreated
0.1963 2@4wk
0.1963 4@4wk
0.3927 4@4wk
0.157 (500) 4@4 wk
a
b
c
Martin, 2014