Species Origin and Diversity

- Native to the Pacific Rim
  - Japan
  - Korea
  - China
  - Taiwan
  - India
  - Philippines
  - Australia
  - New Zealand

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  - Japan
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  - Taiwan
  - India
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  - Australia
  - New Zealand

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Species Origin and Diversity

- *Zoysia japonica*
- *Z. macrantha*
- *Z. macrostachya*
- *Z. matrella*
- *Z. minima*
- *Z. pacifica*
- *Z. pauciflora*
- *Z. planifolia*
- *Z. seslerioides*
- *Z. sinica*
- *Z. tenuifolia*

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Strengths and Uses

- Adapted to a variety of soil types
- Drought response
- Heat tolerant
- Low water use requirement
- Low fertility requirement
- Wear tolerant
- Salt tolerant

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Strengths and Uses

- Some cultivars have shade tolerance

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Strengths and Uses

- …and others do not

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Strengths and Uses

- Great amount of genetic variation for:
  - Color
  - Leaf texture
  - Fall dormancy
  - Winter hardiness
  - Spring green-up
  - Leaf orientation
  - Establishment rate

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Strengths and Uses

- Home lawns
- Tees
- Fairways
- Roughs
- Approaches
- Collars
- Bunker Faces

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Weaknesses

- Variable drought response
- Variable cold hardiness
  - Fine textured species
- Slow Spring green-up
- Slow establishment
- Slow recovery from injury

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Weaknesses

- Shredded leaf tips
- Develop ridges with mowing patterns
- Can become thatchy
  - Scalping
  - Mower will "walk"

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Weaknesses

- Helminthosporium
  - *Bipolaris*
- Large patch
  - *Rhizoctonia*
- Dollar spot
  - *Sclerotinia*
- Dog spot

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'Meyer'

USDA – USGA (1951)

- "Z-52" or "Amazoy"
- Most cold-hardy zoysiagrass
- Deep green color
- Medium leaf texture
- Slow to establish from plugs
- Very dense once established
- Less shade tolerance
- Potentially susceptible to infestation from hunting billbugs, mole crickets, and nematodes

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‘El Toro’

University of California (1986)

- “Toro”
- Good winter color
- Early spring green-up
- Coarse leaf texture
- Fast recuperative potential for zoysiagrass
- Less dense and less thatch
- Fair shade tolerance
- Does well in high pH soils
- Lower water use requirement

‘JaMur’

Bladerunner Farms (1996)

- “Jack Murray”
- Adapted to a wide range of soil conditions
- Quick establishment
- Fast recuperative potential for zoysiagrass
- Medium to coarse leaf texture
- Dense canopy
- Good shade, wear, and drought tolerance

‘Palisades’

Texas A&M University (1997)

- Very good shade tolerance
- Medium broad textured leaf
- High density
- Vigorous recuperative ability
- Good winter hardiness
- Lower water use requirement

‘Crowne’

Texas A&M University (1997)

- Utility turfgrass
- Coa
- Dro
- Low
- Col
- Rap

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‘Empire’

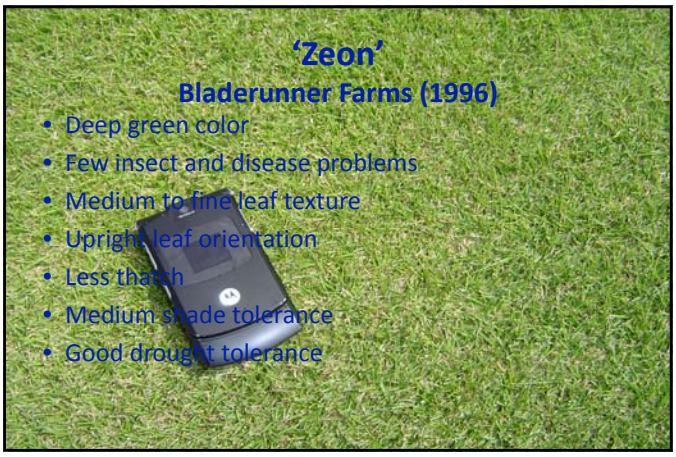
Sod Solutions (1999)

- Blue-green leaf color
- Excellent spring green-up
- Coarse leaf texture
- Slow vertical growth
- Open growth habit
- Tolerance of rotary mowers
- Good drought tolerance
- Reduced maintenance turfgrass

‘UltimateFlora’

University of Florida (2005)

- “Ultimate”
- Fast establishment
- Medium leaf texture
- Upright leaf orientation
- Very dense



'Zorro'

Texas A&M University (2002)

- Fine leaf texture
  - Rapid recuperative ability
- Excellent shade and salt tolerance
- Adapted to the transition zone
  - Good winter hardiness
- Good resistance to the rust, yellow patch, brown patch, billbugs, and fall armyworm
- Low fertility requirement

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‘PristineFlora’

University of Florida (2005)

- “Pristine”
- Deep green color
- Fine to dwarf leaf texture
  - Fast establishment
- Very dense
  - Need thatch management program

Nutrient Management

- Frequent light applications are best
  - Prevents thatch accumulation
  - Enhances spring greenup
  - Prevents disease
  - Improves wear tolerance
  - Improves playability
- Do Not promote excessive green color
  - Encourages thatch
  - Slows spring greenup
  - Promotes disease development
- Early Spring fertilization
  - Late frost can damage and delay greenup
  - Promote large patch development

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Nutrient Management

- Late Fall fertilization
  - Delay spring greenup
  - Promote large patch development
- Enhancing Spring Greenup
  - Apply fertilizer after the turf has become fully green and actively growing.
  - Apply iron
- Potassium
  - Apply at rates equal to nitrogen
  - Improves stress tolerance

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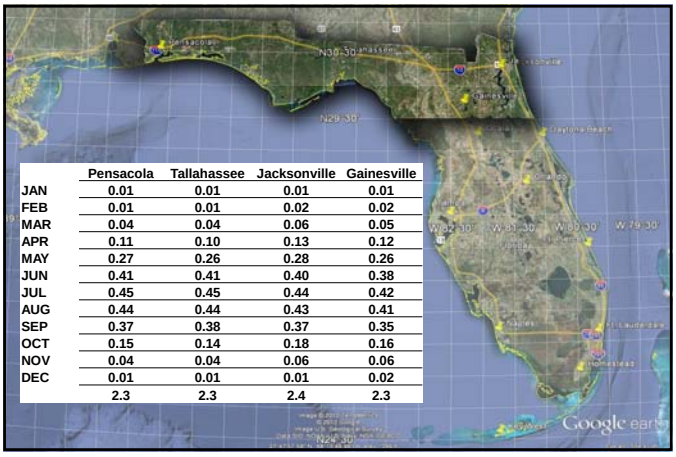
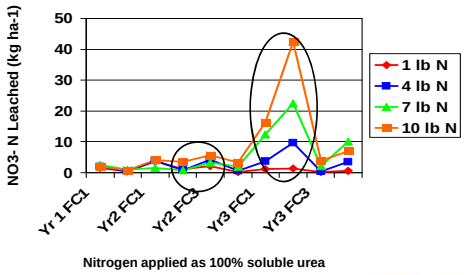


	Pensacola	Tallahassee	Jacksonville	Gainesville
JAN	0.01	0.01	0.01	0.01
FEB	0.01	0.01	0.02	0.02
MAR	0.04	0.04	0.06	0.05
APR	0.11	0.10	0.13	0.12
MAY	0.27	0.26	0.28	0.26
JUN	0.41	0.41	0.40	0.38
JUL	0.45	0.45	0.44	0.42
AUG	0.44	0.44	0.43	0.41
SEP	0.37	0.38	0.37	0.35
OCT	0.15	0.14	0.18	0.16
NOV	0.04	0.04	0.06	0.06
DEC	0.01	0.01	0.01	0.02
	2.3	2.3	2.4	2.3

Nitrogen Rate Study- Nitrate-N Leaching from Empire



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Trenholm et al. 2009

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Mowing Zoysiagrass

- Proper mowing
  - Enhances plant growth and development
  - Never remove more than 1/3 of top growth
  - Stimulates lateral growth (tillers and stolons)
- Cut too close → result in scalping or removal of growing point
- Cut too infrequent → result in scalping as the growing point may be too high.

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Mowing Zoysiagrass

- Reel and Rotary mowers
- Broad range: 0.25 to 2.5 inches
  - Includes all cultivars
- Cultivar and Species Specific
  - *Zoysia matrella* (fine textured)
    - 0.5 to 1.5 inches
    - Exceptions: Diamond, Pristine, Cashmere
      - 0.25 inch
  - *Zoysia japonica* (coarse textured)
    - 1 to 2.5 inches

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Thatch and Zoysiagrass

- Zoysiagrass spreads through the production of lateral stems (rhizomes and stolons).
- Lateral stems are resistant to decay
- Easily result in excess thatch
  - Associated with too much lateral stem production.
    - Influenced by:
      - Nitrogen management
      - Mowing off of more than 1/3 of shoot growth

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Thatch and Zoysiagrass

- Management
  - Zoysiagrass in full sun = thatch
    - Don't fertilize for excess color
    - Frequent light applications of nitrogen
      - decomposition rates = growth rates
  - Home lawns
    - De-thatch (power rake) or scalp each spring
      - Timing → Grass is actively growing
        - » Turf will recover with minimum weed encroachment

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Thatch and Zoysiagrass

- Management
  - Golf Courses
    - Aggressive vertical mowing 1 to 2 times per year
    - Replacement of one normal mowing per week with light vertical mowing
    - Use of groomers in combination with reel mowers

Shade and Zoysiagrass

Cultivar and Species Specific

- *Zoysia matrella*
  - Good to excellent shade tolerance
    - Diamond → excellent
    - Cavalier → Very good
    - Emerald → Good
    - Royal → Good
    - Zorro → Good
    - Zeon →?
    - Pristine →?
    - Cashmere →?
- *Zoysia japonica*
  - Poor to Very good
    - Palisades → Very Good
    - Jamur → Very Good
    - El Toro → Fair
    - Crowne → Fair
    - Empire → Poor
    - Meyer → Poor
    - Ultimate → ?

Empire, UltimateFlora, JaMur
El Toro, Palisades

90% Shade

Cavalier, Zorro, Emerald
Zeon, PristineFlora, Geo

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Shade and Zoysiagrass

- Management
  - Nitrogen Fertility
    - Increases elongation of leaves
      - Excess growth depletes carbohydrates and weakens root system.
    - Limit nitrogen to maintain acceptable color
  - Divert Traffic
  - Increase mowing heights
    - Accounts for elongated leaves
    - ↑ leaf area available for photosynthesis

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Irrigation/Drought Response and Zoysiagrass

- Zoysiagrass will persist through long-term drought.
  - Wilts Quickly
  - Enters Dormancy (avoid)
  - Texas A&M research
    - 60 day drought
      - 7 zoysiagrass cultivars < 1.5% green
      - Floratam St. Augustinegrass – 20% green
      - Tifway bermudagrass – 50% green
      - Celebration bermudagrass – 71% green

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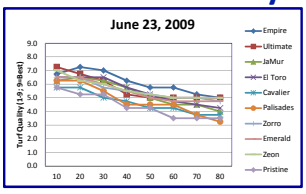
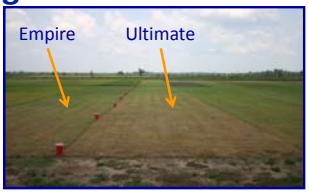
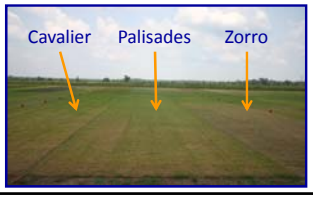
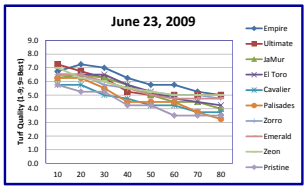
Zoysiagrass

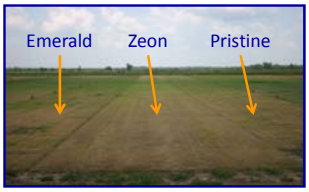






Zoysiagrass





Zoysiagrass

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Herbicides for Zoysiagrass

- Preemergence
  - Oxadiazon – Ronstar
  - Benefin – Balan
  - Benefin + trifluralin – Team 2G
  - Bensulide – Betasan
  - DCPA – Dacthal
  - Dithiopyr – Dimension
  - Oryzalin – Surflan
- Preemergence
  - Oryzalin + benefin – XL2G
  - Pendimethalin – Pendulum
  - S-metachlor – Pennant
  - Prodiamine – Barricade
  - Isoxaben – Gallery
  - Atrazine
  - Prodiamine + sulfentrazone – Echelon
  - Dimethenamid - Tower

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Herbicides for Zoysiagrass

- Postemergence
  - Chlorsulfuron – Corsair
  - 2,4-D
  - Prodiamine + sulfentrazone – Echelon
  - Atrazine/Simazine
  - Dicamba – Banvel
  - Bromoxynil – Buctril
  - Fenoxaprop – Acclaim
  - Fluazifop – Fusilade
  - Carfentrazone +++ (PowerZone, Speed Zone, Quicksilver)
  - Foramsulfuron – Revolver
  - Quinclorac – Drive
- Postemergence
  - Quinclorac ++ (OneTime)
  - Trifloxysulfuron – Monument
  - Clopyralid – Lontrel
  - Fluroxypyr – Spotlight
  - Sulfentrazone – Dismiss
  - Sulfentrazone ++ (Solitare, Surge)
  - Metsulfuron – Manor
  - Pyroflufen-ethyl – Octane
  - Sulfosulfuron – Certainty
  - Thiencarbazone ++ - Celsius

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Diseases on Zoysiagrass

- Large Patch (some refer to it as Brown Patch)
- Dollar Spot
- Bipolaris Leaf Spot Melting Out

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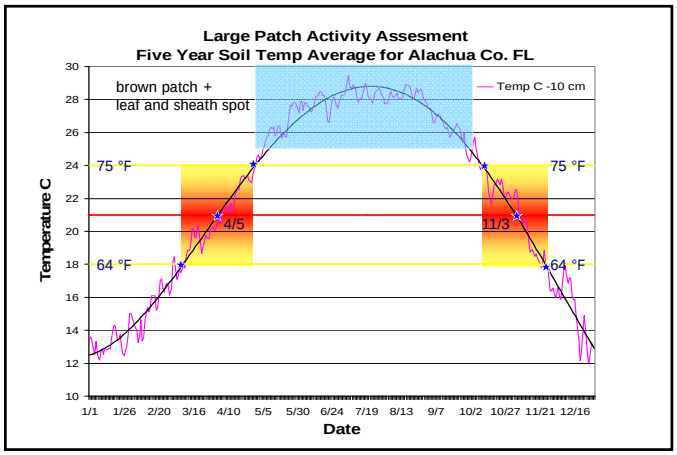

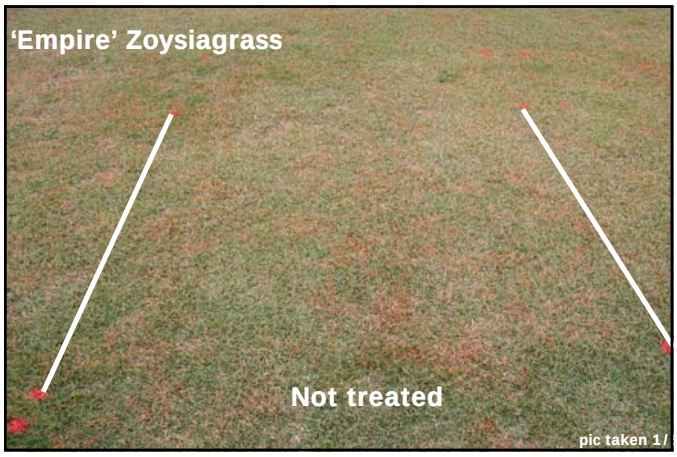

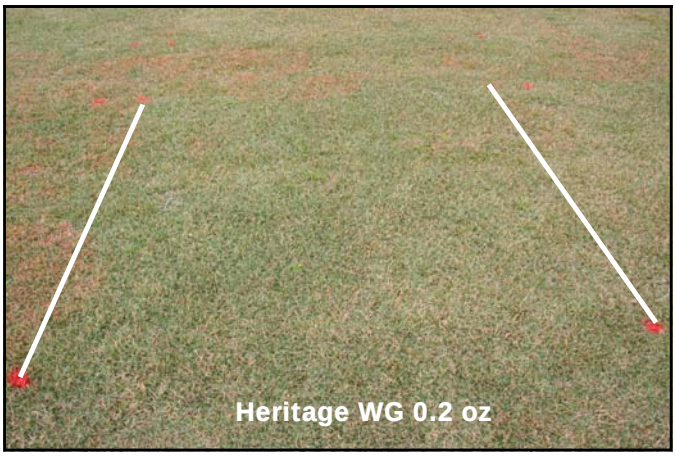

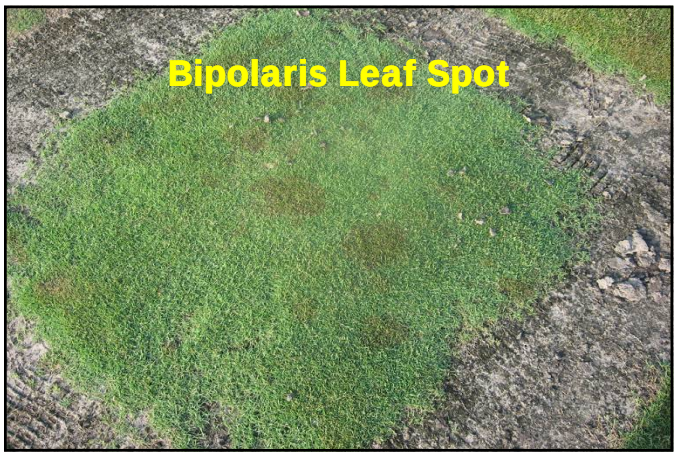

Bipolaris Leaf Spot Melting Out

- Systemic
  - strobilurins
  - DMI's
  - dicarboxamides
- Contact
  - fludioxonil
  - mancozeb
  - chlorothalonil
- Cultural
  - Potassium fertilizers
  - limit leaf wetness
  - thatch reduction

Problematic:

On bermudagrass and zoysiagrass in summer causes small purple patches, can be severe

In fall and winter "melting out" occurs involves crown rot

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Arthropod Pest Complex in Zoysiagrass

- Leaf/Surface Feeders
  - Caterpillars
  - Red imported fire ants
- Stem/Crown Feeders
  - Twolined spittlebugs
  - Billbugs
  - Mites
- Root Feeders
  - Mole crickets
  - White grubs

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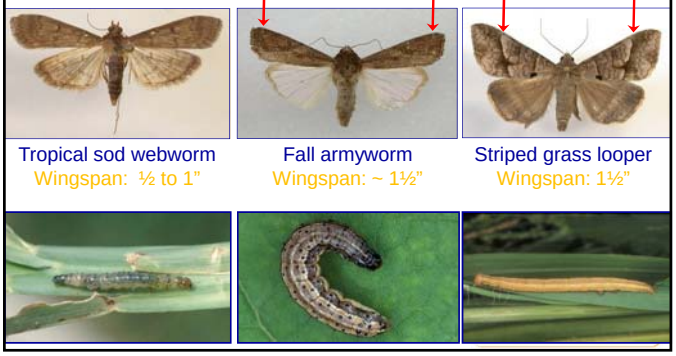
Pest Moths



Tropical sod webworm	Fall armyworm	Striped grass looper
Wingspan: ½ to 1”	Wingspan: ~ 1½”	Wingspan: 1½”

Sod Webworm Damage

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Caterpillar IPM

- Cultural Control:
  - Avoid excessive turf fertilization, especially in late summer
  - Mow at low height and destroy clippings to remove any eggs
- Biological Control:
  - Various natural enemies (stink bugs, spiders, ants, birds, other animals) may help suppress caterpillars
- Chemical Control:
  - Many broadspectrum insecticides are available and effective. Try more selective products like B.t. or Conserve (spinosad) first, if possible

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Billbugs (*Sphenophorus* spp.)

- Gray to black weevils
- Larvae are legless
- Hunting billbug has a Y-shaped area on pronotum with a parenthesis-like marking on each side
- Possibly 2+ generations each year in Florida

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Billbug IPM

- Cultural Control:
  - Keep turf fertilized and moist to survive damage
  - Dethatch to reduce habitat
- Biological Control:
  - Entomopathogenic nematodes kill larvae and adults
- Chemical Control:
  - Preventive insecticides used against grubs should work, but have been less effective in Florida, possibly because of poor timing
  - Curative insecticides have had variable efficacy

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Zoysiagrass Mite (*Eriophyes zoysiae*)

- **Eriophyid mite**
- **Hosts: *Zoysia* spp.**
- **Infests unexpanded leaves, leaf sheaths, collars, seed heads.**
- **Cultivar 'Emerald' is resistant, but 'Belair', Meyer', and 'El Toro' are susceptible.**

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Mite IPM

- Cultural Control:
  - Keep grass properly fertilized and irrigated
  - Scalp turf & destroy clippings
- Biological Control:
  - Natural enemies have not been studied
- Chemical Control:
  - Miticides (Dicofol or Kelthane)
  - Use enough spray volume to penetrate thatch

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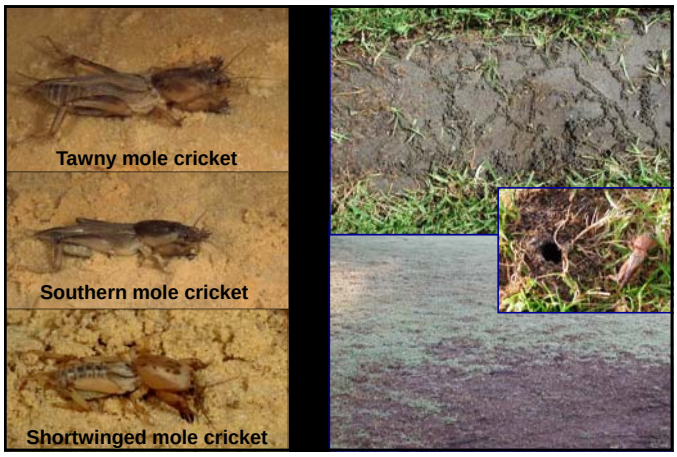

Chemical Control

- Preventive:
  - Treat young nymphs in May/June, soon after egg hatch
    - Many contact insecticides available
- Curative:
  - Treat after damage occurs, usually summer, fall, or spring
    - Baits
    - Spot treatments

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Scarab Beetles

(Coleoptera: Scarabaeidae)

- Dung beetles and plant-feeders (1400 N. American species)
- Scarabs vary in size, color, and habits, but adults can be recognized by their 3-segmented, clubbed antennae
- Larvae molt 3 times (have 3 instars)

Masked Chafers *Cyclocephala* **spp.**

May/June Beetles (*Phyllophaga* spp.)

Green June Beetle (*Cotinis nitida*)

IPM Program for White Grubs

- Identify your pest species or genus
- Determine how many grubs/sq. ft. are damaging
- Cultural controls
  - Soil moisture, soil organic matter, lights, overseed with endophytic ryegrass
- Biological control
  - Wasps, nematodes, pathogens, animals
- Chemical control
  - Know when adult beetles fly; apply preventives during egg lay/hatch

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- Dr. Kevin Kenworthy
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  - – UF Turf Entomologist

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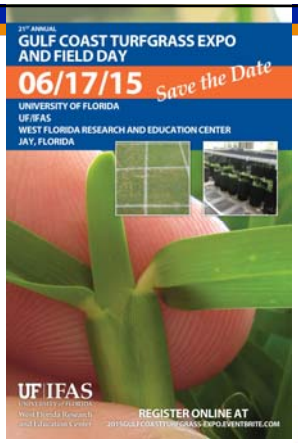

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