Drought Tolerance of Warm-Season Turfgrasses Tested on the Linear Gradient Irrigation System

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Drought Tolerance vs. Drought Resistance

• Drought Resistance = the ability of a plant to survive prolonged drought stress through various mechanisms:
  – Drought Tolerance
    • Escape
    • Hardiness
  – Drought Avoidance
    • Limiting factors influencing soil water uptake
      – deep rooting
      – root viability
    • resistance to soil stresses
    • Limiting evapotranspiration (ET)

A better phrase may be: Drought Response

• Grasses undergo many changes in response to drought.
  – Many of these responses go unnoticed but have a profound effect on the plant’s ability to withstand drought.
    • Some are often very difficult to quantify.
  – Others are readily observed and easily quantified.
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• Ability of a turfgrass to tolerate a drought period.
  – Escape – the plant has a life cycle such that it lives through the drought in a dormant state or as seed.
  – Hardiness – the plant develops a greater hardiness to low tissue water deficits.
  • Drought tolerance of protoplasm and protoplasmic membranes from alterations in their properties, and binding of water to protoplasmic constituents.
  • Osmotic adjustments to maintain adequate tissue water content.

**Influence of Drought on Turfgrass Rooting**

![Graph showing the influence of drought on turfgrass root biomass](image)

**Comparative Turfgrass ET Rates and Associated Plant Morphological Characteristics**

- Canopy Resistance
- Shoot Density
- # Leaves / Area
- Leaf Width
- Vertical Leaf Extension Rate
- Total Leaf Area = Evaporative Area
- Leaf Orientation

The plant is able to maintain adequate tissue water content and thus avoid or postpone the stress.
So what’s the bottom line?

- As a drought is imposed on a grass, various drought resistance mechanisms operate at different points during the dry-down.

Materials and Methods

- Greenhouse dry down study
  - RCBD with 4 replications acrylic tubes (3.8 X 90 cm) and fritted clay
  - Controlled dry down: less than 10% of available soil water reduced every day

Linear Gradient Irrigation System (LGIS)

- Previous studies on LGIS (Banuelos et al., 2011; Peacock, 2001; Qian and Engelke, 1999)
  - Determine minimal and optimal water requirements
  - Evaluate drought responses of different species and cultivars

Jing Zhang and Bishow Poudel
Former Ph.D. students @ UF

Materials and Methods

- Field dry down study
  – Location: Plant Research and Education Unit (PSREU)
Materials and Methods

• Plot establishment (RCBD with 4 replications)
• Plot size (10’ × 80’)
• Irrigation (twice weekly, 120% of ET₀)

Materials and Methods

• Zoysiagrass
  — Toccoagreen, Zeon, Zorro, Emerald, Cavalier, El Toro, Empire, JaMur, Palisades, ‘BA-189’
• St. Augustinegrass
  — Floratam, Classic, Palmetto, Raleigh, Sapphire, Captiva
• Bermudagrass
  — Common, Celebration, Princess 77, TifTuf, Tifton 10
• Seashore Paspalum
  — Aloha, SeaDwarf, Seaside Supreme
• Bahiagrass
  — Argentine
• Centipedegrass
  — Common, TifBlair
• Buffalo grass
  — Density

Materials and Methods

• Identified dates of drought periods:
  — June, 2009
  — September, October, 2010
  — May, June, and July, 2011
Results

• Among St. Augustinegrass cultivars - Palmetto had lower quality compared with Captiva, Classic, Floratam and Raleigh except when irrigation level was more than 80% ET₀.
  – These 4 cultivars had similar quality, and they performed no differently with Argentine bahiagrass at 37-105% ET₀ irrigation level.
• This indicates St. Augustinegrass can perform equivalently to bahiagrass when certain levels of irrigation is applied.
  – In this case, more than 37% ET₀.

Zoysiagrass

• Irrigation requirement of zoysiagrass
  – 54-80% ET₀ irrigation is needed to prevent turf quality decline below 5.5
• Excess irrigation had negative effect on turf quality of zoysiagrass
  – Future study
    • Root penetration
    • Disease and weeds
Rainfall vs. Evapotranspiration - 2016

Florida Panhandle (Carrabelle/Jay)

Irrigation Needs – Florida Panhandle

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Bermudagrass & Buffalograss

Water Efficiency

Tifway Celebration Princess 77 Buffalograss Tifton 10

Water Use Efficiency

Vadisy

Chlorophyll Index
Cultivar comparison

- Bermudagrass (BD) genotypes comparison
  - T10 (lower color, quality, and density ratings, and lower Chlorophyll index)
  - TifTuf had higher chlorophyll index (CI) than other bermudagrass genotypes (except Princess 77) when the irrigation level was < 105% ETc.
    - Although visual ratings provided less separation, TifTuf maintained higher quality at all irrigation levels.

Results

- Common and TifBlair centipedegrass - rated in the top group along all irrigation levels.
  - Argentine bahiagrass was rated similarly in quality to centipedegrass

Preliminary Observations

- All grasses respond to drought – they just do it differently.
  - Zoysigrasses wilt and fire very quickly and very uniformly (green → brown).
  - St. Augustinegrass fades over time with some green foliage lingering for weeks (green → yellow-green → yellow → brown).
  - Centipedegrass wilts quickly but also recovers (turns green again) very quickly.
  - Seashore paspalum can be very slow to recover due to the plant’s priority on producing below-ground plant parts.
  - Bermudagrass and bahiagrass are very drought responsive but may not provide the desired turf quality.
Multi-Location Trial to Establish Maintenance Requirements and Performance of New Bermudagrass Cultivars for Fairway Use

- Bermudagrass Cultivars:
  - Tifway 419 Celebration
  - TifGrand
  - TifTuf
  - Latitude 36
  - Bimini
  - Premier Pro (GNV & JAY)

- Turfgrass Performance
- Drought Response
- Fertility Requirements
- Playing Surface Performance

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