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DROUGHT RESPONSE OF TURFGRASSES:
Assessment Using a Linear Gradient Irrigation System

BLOGGING
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DROUGHT RESPONSE of TURFGRASSES:

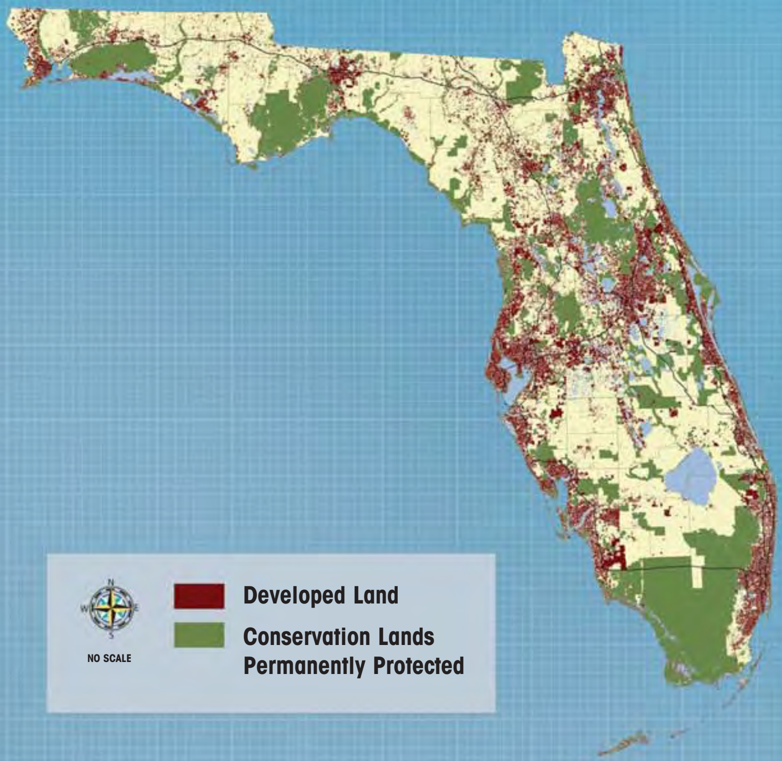
Assessment Using a Linear Gradient Irrigation System

By J. Bryan Unruh, Associate Professor, University of Florida

Hear Ye, Hear Ye: Read all About It! "The Devil Grass: Water-hungry St. Augustinegrass Sucking up Fresh Water"[1] and "Thirsty Grass Has Evil Roots"[2] are headlines from prominent newspapers in Florida. These inflammatory headlines, often void of sound science, are puzzling and they leave green industry professionals and gardening enthusiasts confused about which turfgrass performs the best in Florida's diverse climatic conditions.

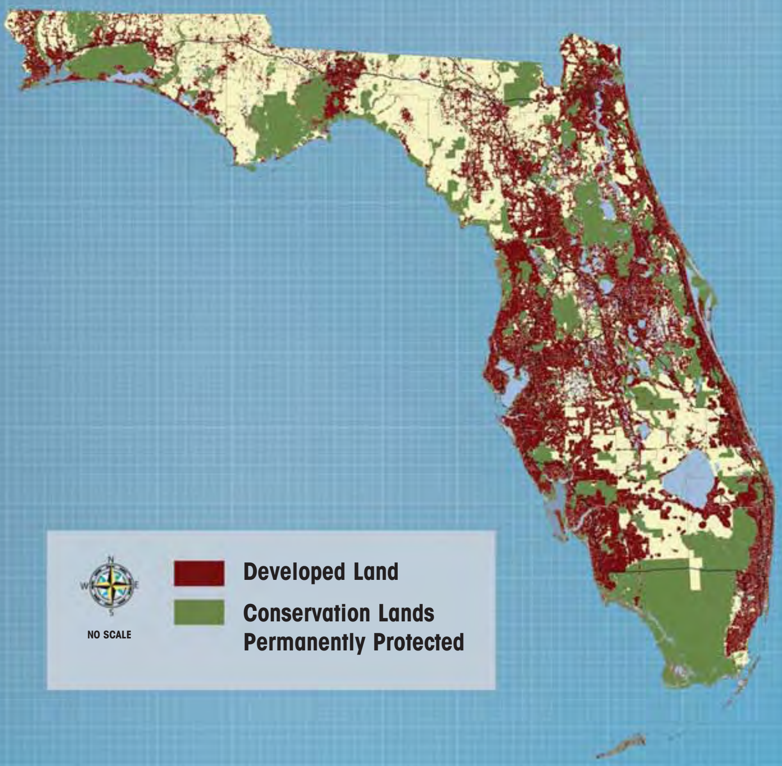
All agree that Florida's population is expected to steadily increase in the years ahead. Maps showing current (Fig. 1) and projected development (Fig. 2) in Florida are alarming. As development continues and the population swells, huge constraints on Florida's natural resources—especially potable water—are inevitable. As the battle rages over water use, elected officials and regulators are caught in the unenviable position of trying to balance supply and demand.

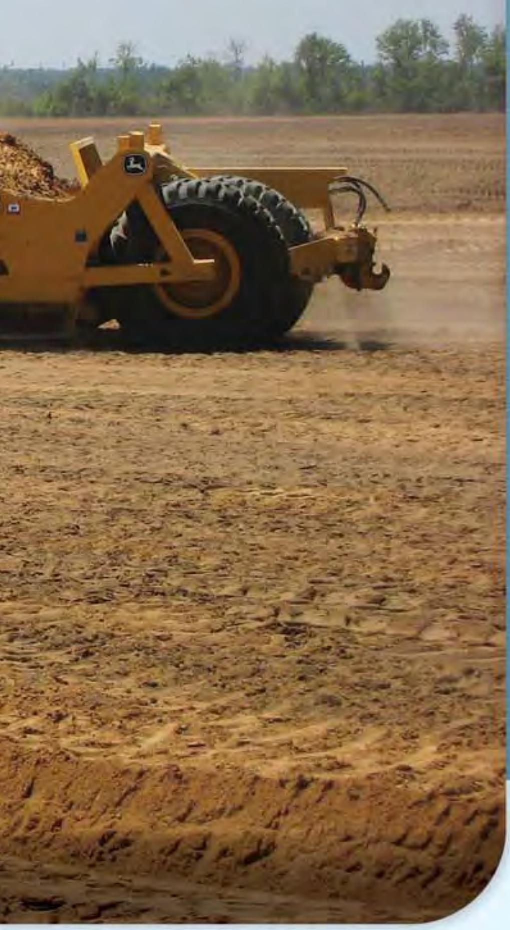
In recent years, we have seen examples of what is to come. Ordinances



Above: Fig. 1. Florida Today. Available at http://www.1000friendsofflorida.org/PUBS/2060/2060-executive-summary-Final.pdf.

Below: Fig. 2. Florida in the year 2060. Available at http://www.1000friendsofflorida.org/PUBS/2060/2060-executive-summary-Final.pdf.





Above: Fig. 3. Initial stage of construction involved removing 12" of topsoil and stockpiling it.

placing square footage restrictions on turfgrass have been imposed by county governments and local municipalities in an effort to restrict the demand for

Fig. 4. The subgrade was laser-leveled and shaped to provide a 5" drop from the outside inward to ensure all surface water flows to the center as evidenced during the rain event.

water (i.e., fewer plants = less outdoor water use). Similarly, Water Management Districts have imposed water use restrictions (e.g., one, two or three days per week; limited hours for irrigation) in an attempt to curtail outdoor water usage.

These restrictive efforts have been met with fierce opposition by those in the green industry, because these restrictions can severely cripple the financial viability of green industry businesses. Green industry suppliers and service businesses correctly argue that plants do not waste water—people do. As such, an informed citizenry—obtained through proper education and outreach—is the best defense to curb wasteful water use practices.

Proper education is better than regulation

Good education requires a clear understanding of the issues at hand. One aspect of this complex turf/water/drought issue that lacks clarity and has great confusion is the terminology used to define a plant's ability to handle drought conditions. For the purpose of clarity, ***Drought Resistance*** is the ability of a plant to survive prolonged drought stress through *Drought Tolerance* and *Drought Avoidance* mechanisms.

Drought Tolerance occurs when plants either "escape" the drought through life cycle modifications such as entering dormancy sooner or producing seed for regeneration purposes.

Plants may also tolerate the drought through cellular level adjustments making them hardier.

Drought Avoidance occurs when plant factors are modified. For example, certain turfgrass species grow deeper roots or have enhanced root viability. Both of these factors influence soil water uptake. Turfgrasses with deeper roots can mine the water from greater soil depths. Additionally, certain plants have the ability to limit or reduce evapotranspiration (ET), allowing them to avoid drought

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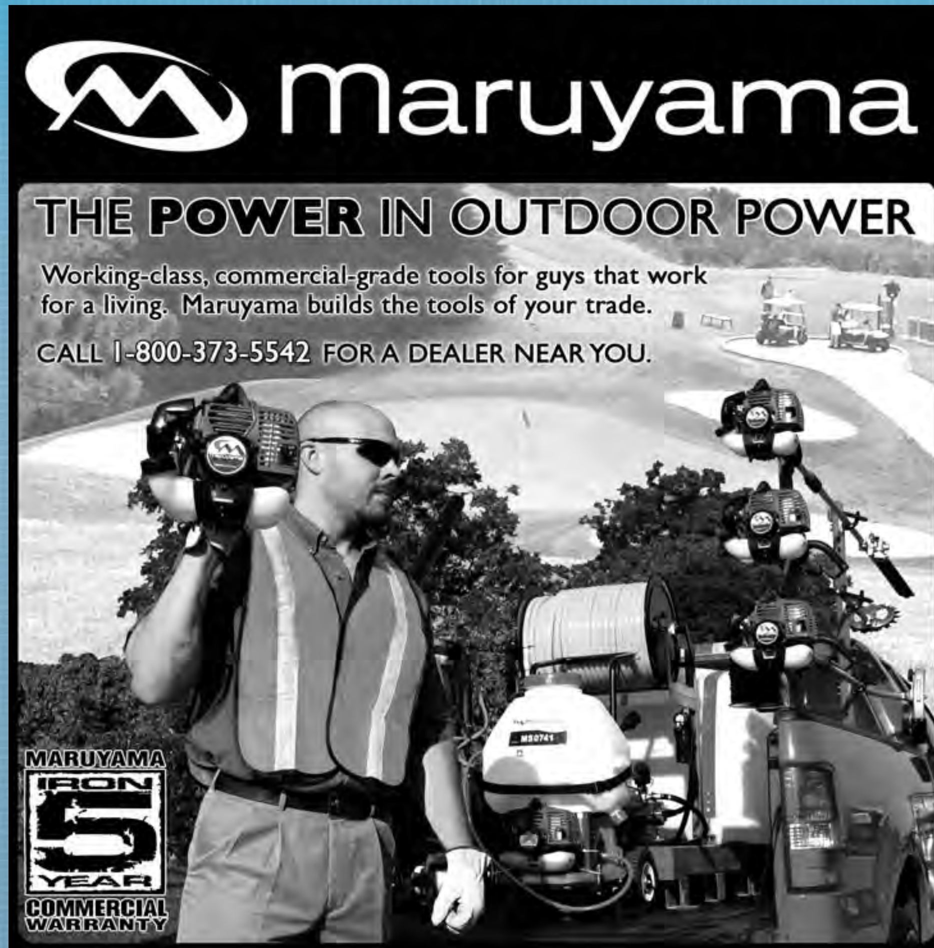

stress. Factors such as shoot density, number of leaves per unit area and leaf orientation all affect ET rates. Similarly, leaf width and leaf extension rate contribute to the total leaf area. A larger leaf area equates to a larger evaporative surface and generally equates to greater water usage. When a plant is able to maintain adequate tissue water content, it can **avoid** or postpone the stress.

Some of the UF Turf Team members think that a better phrase to use when talking about the influence of drought on turfgrass is ***Drought Response***.

Grasses undergo many changes in response to drought and some of these responses are not easily noticed. However, they have a profound effect on the plant's ability to withstand drought. Some of these changes can be very difficult to quantify in the laboratory. Other changes are readily observed and easily quantified. With this in mind, and the fact that limited field research in Florida has documented which turfgrass actually performs best under drought conditions, we initiated a project to gain a better understanding of the drought response of the major turfgrass species and cultivars grown in Florida.

Construction of a drought research facility

In April 2007, we began construction of a three-acre Linear Gradient Irrigation System (LGIS) at the University of Florida, West Florida Research and Education Center (WFREC) near Pensacola, Fla. The system was modeled after a system designed and installed at Texas A&M University by Dr. Milt Engelke.

At the onset of construction, 12" of topsoil was removed and stockpiled using heavy equipment (Fig. 3). The subgrade was shaped and laser-leveled to provide a 5" drop from the outside edges inward to ensure that all surface water flows to the center (Fig. 4). After the subgrade was established, the topsoil was replaced and the final grade was established using laser-guided implements.

The LGIS has a triple row irrigation system with the central line having an irrigation head spacing equal to 33 percent of the throw of the irrigation

Fig. 5. Twenty-eight turf cultivars were planted on 10' X 80' plots perpendicular to the line of the irrigation heads.

heads. This spacing allows for considerable overlapping from head to head and ensures uniform distribution of water perpendicular to the irrigation line. The outside rows of irrigation heads are triangulated to the central head of the center trench and were used only during the establishment period to ensure uniform plot establishment and when fertilizer treatments need to be watered in. In September 2008, 27 commercially available turf cultivars (Table 1) were planted on 10' X 80' plots running perpendicular to the center irrigation line (Fig. 5). This allows for the comparative performance of each of the grasses under very high water application (center of the LGIS) to the outer edge which receives no supplemental irrigation. All

Fig. 6. Turfgrass breeding lines (African bermudagrass, zoysiagrass, carpetgrass, and centipedegrass) from Dr. Kevin Kenworthy's program were plugged on 18" centers on the LGIS.

Fig. 7. A dry period in June 2009 allowed for some initial data collection from the turfgrass cultivars planted on the LGIS.

of the sod and shipping costs were donated by sod producers from Florida, Alabama, Georgia, South Carolina and Texas. An additional 30 turfgrass breeding lines (African bermudagrass, zoysiagrass, carpetgrass and centipedegrass) from Dr. Kevin Kenworthy's program were plugged on 18" centers (Fig. 6) and the University of Georgia experimental line, DT-1, was added to the LGIS in early 2010.

Since 2009, periodic drought conditions have allowed us to capture some field data (Fig. 7). Because of seasonal and annual variations in climatic conditions, conclusive results from this research will not be available for several years. For more information on this project or others conducted by Dr. J. Bryan Unruh, please contact him at jbu@ufl.edu.

[1]http://staugustine.com/stories/112507/news_017.shtml
[2]http://www.seminolechronicle.com/vnews/display.v/ART/4797cfd2a03a5

Table 1. Turfgrass cultivars currently installed in the Linear Gradient Irrigation System at the University of Florida, West Florida Research and Education Center.

1	Floratam St. Augustinegrass
2	Classic St. Augustinegrass
3	Palmetto St. Augustinegrass
4	Raleigh St. Augustinegrass
5	Sapphire St. Augustinegrass
6	Captiva St. Augustinegrass
7	Empire Zoysiagrass
8	Ultimate Zoysiagrass
9	JaMur Zoysiagrass
10	El Toro Zoysiagrass
11	Cavalier Zoysiagrass
12	Palisades Zoysiagrass
13	Zorro Zoysiagrass
14	Emerald Zoysiagrass
15	Zeon Zoysiagrass
16	Pristine Zoysiagrass
17	Tifway Bermudagrass
18	Celebration Bermudagrass
19	Princess 77 Bermudagrass
20	Density Buffalograss
21	T10 Bermudagrass
22	Common Centipedegrass
23	TifBlair Centipedegrass
24	Argentine Bahiagrass
25	DT-1 Bermudagrass
26	SeaDwarf Seashore Paspalum
27	Aloha Seashore Paspalum
28	SI Supreme Seashore Paspalum