Water Issues for Turf: Drought

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LIMITING FACTORS IN TURF GROWTH

Growth rate increases

Limiting factor
LIMITING FACTORS IN TURF GROWTH

Growth rate increases

Limiting factor

Light
LIMITING FACTORS IN TURF GROWTH

Growth rate increases as the limiting factor increases.

- Temperature
- Light
LIMITING FACTORS IN TURF GROWTH

Growth rate increases

Limiting factor

Moisture

Temperature

Light
LIMITING FACTORS IN TURF GROWTH

Growth rate increases

Limiting factor

- Light
- Temperature
- Moisture
- Mineral Nutrients
LIMITING FACTORS IN TURF GROWTH

Growth rate increases

Limiting factor

Light

Temperature

Moisture

Mineral Nutrients

Oxygen

Pest problems

Light
Atmospheric Drought

Short Term Water Deficits: due to ET Rate exceeding the Absorption Rate EVEN if available soil water levels are adequate

- Usually less severe and of shorter duration
Physiological Drought

Prolonged Water Deficits by Lack of Available Soil Water:

- Plant growth is slowed
- Tissues wilt
- Death, eventually
Misconceptions

- Drought resistance

versus

- Drought Hardiness
Drought resistance

The ability of a plant to survive an unfavorable external moisture stress.

- **Escape - avoidance**
- **Dormancy - avoidance**
- **Increased water absorption capacity**
- **Xeromorphic features – delays dehydration**
- **Physiological Capability to Endure Dehydration - delays dehydration**
Grasses have a short life cycle during the rainy season

- Germinate, establish, mature and produce seed within a short time when soil moisture level is favorable

Examples: Annual bluegrass, annual grassy weeds — crabgrass, goosegrass
Dormancy - *avoidance*

Survival by going into a true dormant state.

Shoot growth ceases and death of the aboveground leaves occurs under severe soil drought.
Dormancy - avoidance

Buds in the crown, stolons and rhizomes of dormant grasses survive the drought and initiate new growth when favorable soil moisture conditions develop.

Buds are extremely drought hardy because of the small cells that are devoid of vacuoles. – KEY POINT!
Diagram of a cell

http://www.cellsalive.com/cells/cell_model.htm
Mechanism of Drought Injury

Mechanical injury:
A result of the drying and remoistening processes rather than to the lack of water itself.

The outward diffusion of water causes the vacuole to shrink and the protoplasm to be pulled inward.

The cell wall resists collapse if it is relatively rigid.
Mechanism of Drought Injury

Mechanical injury:
The protoplasm is subjected to stress in this case caused by the inward pull of the shrinking vacuole and the outward pull resulting from adherence to the rigid cell wall.
The resulting mechanical disruption of the dehydrated protoplasm causes death of the plant tissue.
Similar stresses may occur during the remoistening process when the cell wall distends more rapidly than the protoplasm.
Mechanism of Drought Injury

Mechanical injury:

Is a main reason that during drought, caution is advised about starting and stopping irrigation.

Unless you are prepared to *continue* irrigation until the drought situation is over, starting and then stopping can be more injurious than not starting at all.
Brown, dead leaves serve as a mulch to reduce water loss by evaporation, thereby providing additional protection for the dormant plant tissues.
Breaking of Dormancy

Can occur within 3 to 5 days after a substantial rain:

- Kentucky bluegrass
- Bermudagrass
Water Absorption Capability

- Rooting depth
- Root number
- Degree of branching
- Extent of the root hair zone
- Root growth activity
Rooting Characteristics

Misconceptions:

- A deep extensive root system provides a greater capability to survive drought only if water is present at the lower soil depths.
Rooting Characteristics

Misconceptions:

- A deep extensively rooted turf is not necessarily drought hardy.
- It only has the capability of absorbing water from a lower soil horizon and a greater volume of soil, thus prolonging the length of time before the turf is subject to wilt.
Turfgrasses vary *genetically* in their rooting characteristics:

Many have a relatively shallow but fibrous, dense root system that can exhaust the available soil moisture in the root zone within 1 to 4 weeks, sometimes sooner.
Rooting Characteristics

Turfgrasses vary *genetically* in their rooting characteristics:

Among the cool-season grasses — Tall fescue is deep rooted while Kentucky bluegrass is intermediate. Bermudagrass has a deep, extensive root system while bahiagrass ranks intermediate.
Water Absorption Capability

Root growth activity
COOL-SEASON GROWTH CALENDAR

Winter | Spring | Summer | Fall | Winter
Shoot growth | Root growth | Shoot growth | Root growth

WARM-SEASON GROWTH CALENDAR

Winter | Spring | Summer | Fall | Winter
Shoot growth | Root growth | Shoot growth | Root growth
Some turfgrasses possess inherited structural modifications that reduce the water loss by transpiration when a water deficit occurs. Typical examples are bermudagrass, zoysiagrass and tall fescue.
Xeromorphic Features

Features that reduce transpiration:
- Decreased leaf surface area
Xeromorphic Features

Features that reduce transpiration:

- Decreased leaf surface area
- Altered size, spacing, number and location of stomata
Xeromorphic Features

Features that reduce transpiration:

- Decreased leaf surface area
- Altered size, spacing, number and location of stomata
- Increased cuticle thickness
- Presence of surface hairs
Xeromorphic Features

Features that reduce transpiration:

- Decreased leaf surface area
- Altered size, spacing, number and location of stomata
- Increased cuticle thickness
- Presence of surface hairs
- Rolling and folding of the leaves
Drought Hardiness

The ability of the plant to survive desiccation.

- Drought hardy tissues usually have a small cell size with a small vacuole that reduces the amount of contraction and associated protoplasmic stress.
Drought Hardiness

The ability of the plant to survive desiccation.

- Drought hardy species generally have a high cell sap concentration and high osmotic pressure which increases the ability of cells to retain water, which lessens the degree of cell contraction.
Factors in Drought Hardiness

Varies with stage of development:
Semi-resting dormant buds on rhizomes and stolons are very drought hardy.
When the resting stage of dormant organs is broken and seedling growth is initiated, the tissues still retain a considerable degree of drought tolerance when compared to mature tissues.
Factors in Drought Hardiness

The growth rate and resulting physiological state of the tissue are also factors:

Slow growing tissues with a small cell size and a high carbohydrate content are more drought hardy.

Cultural practices that avoid excessive growth stimulation increase drought hardiness.
Factors in Drought Hardiness

Things to avoid:

- High N rates – stimulates rapid shoot growth, enlarges cell size, increases tissue hydration.
- K deficiency – affects cell osmotic content
- Shading – reduces carbohydrate content, increases succulence
- Intense traffic
Factors in Drought Hardiness

Things to avoid:
- Light frequent irrigations – exhaust carbohydrate reserves
Factors in Drought Hardiness

Turfgrasses grown under a limited soil moisture level have greater drought hardiness than when grown under an adequate moisture level.

It is better to restrict irrigation than to intensively irrigate for a portion of a drought period and then miss several weeks.
Drought Resistance* of Turfgrasses

- Excellent
  - Buffalograss
  - Bermudagrass
  - Zoysiagrass
  - Bahiagrass

- Good
  - Hard fescue
  - Tall fescue

- Medium
  - Kentucky bluegrass

*Turfgrasses ranked on a basis of drought hardiness do not necessarily have a similar drought resistance ranking
Excess Water

- Injury to flooded or waterlogged turfgrasses is seldom caused by the direct effect of water but by the lack of aeration.

- The resultant oxygen deficiency in the soil restricts root growth and causes a general decline in turfgrass quality, vigor, and rooting depth.
Excess Water

- Affects nutrient management in that denitrification is greater under anaerobic water-logged soil conditions and more leaching of soluble nutrients such as N and K will occur.
Excess Water

Turf injured or weakened by high soil moisture conditions:

Aerify
Fertilize
Avoid irrigation
Scout and treat for algae – 2 to 3 lbs of hydrated lime per 1000 sq.ft.