Atmospheric Environment of Turfgrasses

Atmospheric conditions affecting turf
- Result from seasonal and daily fluctuations in the weather
- Measurable conditions:
  - Temperature, moisture, light and wind

Atmospheric Conditions
- Daily changes in atmospheric condition
  - Attributable to the rotation of the earth about its axis
- Seasonal changes
  - Result from the revolution of the earth about the sun

Atmospheric Conditions
- Water bodies tend to modify diurnal and seasonal temperature fluctuations

Atmospheric Conditions
- Temperature decreases with altitude
- Cultivation of cool season grasses in the tropics at higher elevation
Light - Solar Radiation

Turfgrasses absorb 50 to 80% of incident solar radiation depending on leaf orientation.

Light

- Turfgrasses convert only 1-2% of incoming light into chemical energy during photosynthesis.
- Remainder:
  - Reradiated at longer wavelengths
  - Transmitted
  - Reflected
  - Absorbed

Light

- Turfgrasses respond to light intensity:
  - Altering leaf orientation
    - High intensity > horizontal orientation
    - Moderate intensity > upright orientation

Light

- Shading changes plant structure:
  - Longer and thinner leaves
  - Reduced density and tillering
  - Shallower rooting, thinner cuticles, lower reserve carbohydrates
  - Failure under very low light intensity
Light

- Shade turf
  - Less tolerant to wear, disease, and environmental stresses

Light

- Shading affects microclimate
  - Moderated diurnal and seasonal temperatures
  - Restricted air movement
  - Increased relative humidity
- Results may be beneficial or detrimental

Light

- Light requirement
  - Energy for maintenance
    - Off setting respiration during day and night
  - Energy for growth
    - Off setting losses from natural senescence and mechanical damage

Light

- Light Exclusion
  - Obstacles that block light penetration
  - Substantial injury under high-temperature conditions

Light

- Cultural management for shading
  - Pruning
  - Removing leaves
  - Removing other objects
  - Reducing traffic
  - Switch from turf to shade tolerant plant types

Light

- Cultural adjustments to low light levels
  - Raising mowing height
    - Compensate for upright growth
  - Reduce nitrogen fertilization rate
  - Reduce irrigation frequency
  - Monitor for diseases in stressed turf
Light

- **Photoperiod**
  - Period of time that a turfgrass is exposed to light
  - Effects on flowering
    - Cool season grasses are long day plants

- **Photoperiod effects on vegetative growth**
  - Short day
    - Increased density and tillering
    - Shorter leaves, smaller shoots, and a more prostrate growth habit

Temperature

- **Expression of heat energy from solar radiation**
- Heat energy received can be transferred

- **Heat Islands turfs**
  - Intense stress as adjacent areas absorb and reradiate heat energy

Temperature

- **Heat transfer processes**
  - Evaporation
  - Radiation
  - Conduction
  - Convection
  - Advection

- **Evaporation/Transpiration**
  - Changing of water from a liquid to a gas
  - Cooling of the plant
- **Radiation**
  - Increases in air temperature as solar radiation is reradiated in form of heat into the atmosphere
Temperature

• Convection
  – Heated air rises over plant surfaces
  – Transfer of heat from the plant to atmosphere

• Advection
  – Air passing over warmed surfaces picks up heat and transfers it to other sites downwind

Temperature management in turf
  – Promoting transpirational cooling
    • Adequate supply of plant available moisture
    – Removing obstacles to air flow

Cardinal temperatures in turfgrass growth

• Optimum Growth Temperature
• Maximum Growth Temperature
• Minimum Growth Temperature
• Min. Survival Temperature
• Max. Survival Temp.

Daily temperature fluctuations
  – Significant temperature changes close to the soil surface
  – Temperatures above turfgrass is lower compared to many other surfaces

Temperature fluctuations
  – Determine duration of optimum growth
  – Determine limits of adaptations of turf
    • Cultural practices can extend limits of adaptations
Temperature

- Temperature changes
  - Latitude and altitude
  - Topography

Moisture

- Up to 90 percent of total mass is water in actively growing turfgrasses

Moisture

- Water functions
  - Maintaining cell turgidity
  - Transporting nutrients and organic compounds
  - Raw material for chemical processes
  - Buffering against temperature fluctuations

Moisture

- Tissue Cooling

Moisture

- Exiting water surrounds the leaf with moist air
  - Boundary layer
    - 1 to 10 mm
  - Reduces rate of transpiration
Moisture

• Moisture stress
  – Release of hormones
    • Induces stomata closure
    • Promotes root growth
  – Grass may go dormant
  – Wilting and death

Moisture

• Drought avoidance
  – Reduce leaf area
    • Tight folding or rolling of leaf blades

Moisture

• Forms of moisture
  – Precipitation
  – Irrigation
  – Water vapor
  – Dew

Moisture

• Water vapor content = relative humidity
  – Directly proportional to temperature
    • Higher temperatures – more moisture can be held
    • Dropping temperature leads to condensation
  – Determines precipitation and transpiration
    • Distribution of grasses and other plant species

Moisture

• Dew
  – Resulting from gutation and condensation
  – May result in enhanced fungal growth and leaf burning
  – Conserves water by delaying onset of transpiration
Moisture

- Gutation
  - Exuding of plant moisture from openings, called hydathodes, at the leaf tips

- Frost, snow, and ice
  - May protect turf from desiccation
  - May enhance disease problems
  - Damage to growing points

Wind

- Effects on turf
  - Transport of debris.
  - Mixing action
  - Injury

- Air circulation
Wind

- Mixing action
  - Boundary layer of a leaf can be dispersed

Wind

- Mixing action
  - Dispersal of excessive heat and moisture accumulations

Wind

- Preventing hot and humid microclimate to develop
  - Disease pressure

Wind

- Desiccation injury

Turfgrass Mixture

- When atmospheric or soil conditions are not uniform
  - Light, soil, temperature, fertility, traffic
  - Disease pressure

- Selection based on range of conditions
  - Limited range of single species to variable conditions

Turfgrass Mixtures

- Benefits
  - Reduced overall turf damage to disease
  - Better shade adaptations
  - Improved wear resistance
  - Improved recuperative capacity
Turfgrass Mixtures

• Guidelines – select species or cultivars
  – Adapted to the site
  – Resistant to local diseases
  – Similar in appearance and competitive abilities
  – At least three cultivars