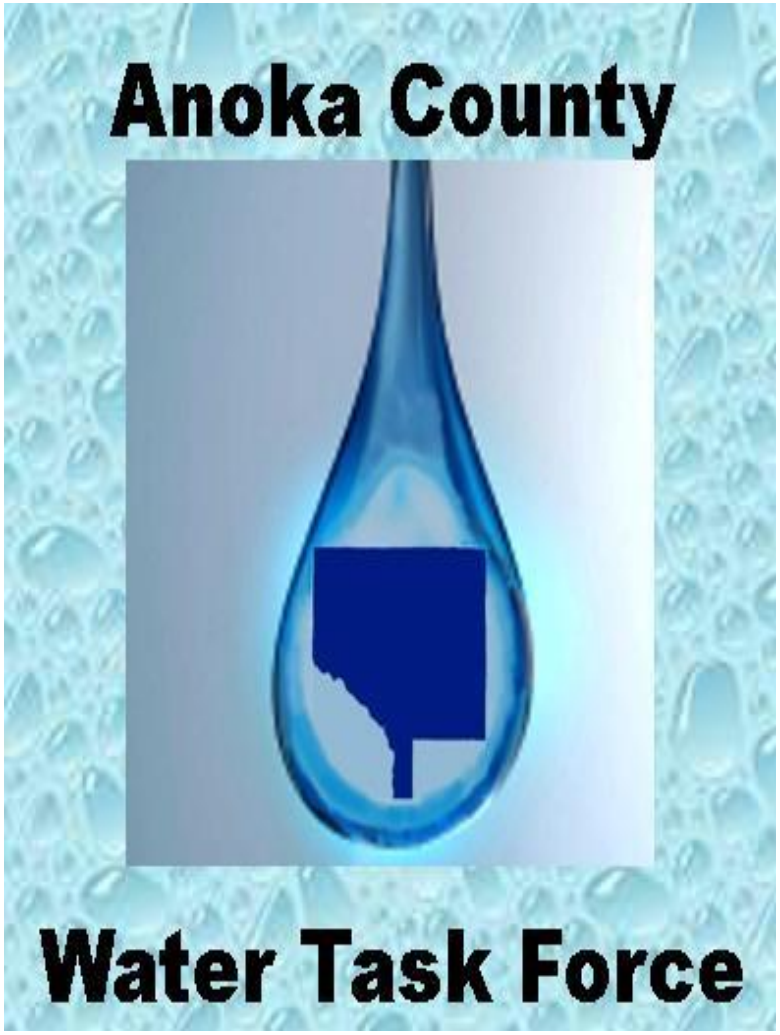
Smart Irrigation Forum

Thursday, July 16, 2015 (6:00 PM)

at Bunker Hills Activity Center

550 Bunker Lake Blvd NW, Andover, MN 55304

Anoka County
MINNESOTA
Respectful, Innovative, Fiscally Responsible



Anoka County Community Health and Environmental Services

Water Resources Report

2014

Smart Irrigation Forum

SAM BAUER, EXTENSION EDUCATOR- TURFGRASS SCIENCE

BUNKER HILLS ACTIVITIES CENTER, JULY 16TH, 2015

ON TONIGHT'S MENU

- Background on water use and irrigation
  - Evapotranspiration
- Soil moisture dynamics
  - Fate of water
  - Soil type differences
- Irrigation- how much, how often, when, how
- Strategies to reduce water use

Water use and irrigation

Woodbury issues plea to limit lawn watering

By Bob Shaw
bshaw@pioneerpress.com

POSTED: 06/19/2014 12:01:00 AM CDT | UPDATED: 3 MONTHS AGO

Woodbury residents and businesses are probably overwatering their lawns.

The city pumped 9.3 million gallons of water to its customers Saturday, which is more than twice as much as is pumped on a typical winter day, according to a news release.

But it rained about 2 inches that day.

Officials suspect that automatic irrigation systems are to blame.

The city is recommending that homeowners make sure their sprinkler systems have working rain sensors. An alternative is to turn off the timer and start the system manually only when the lawn is dry.

The city's rules call for odd-numbered addresses to water lawns only on odd-numbered days and even-numbered addresses on even-numbered days. Watering is allowed before noon and after 5 p.m.

5:30am Monday, July 13th after 1.8 inches of rain on Sunday night

Main causes of excessive water use on lawns and turf?:

Grass species? Mowing height?

Lawns constructed with poor soils?

Our misperception of how much water lawns need?

Irrigation irresponsibility?

Expectations are too high?

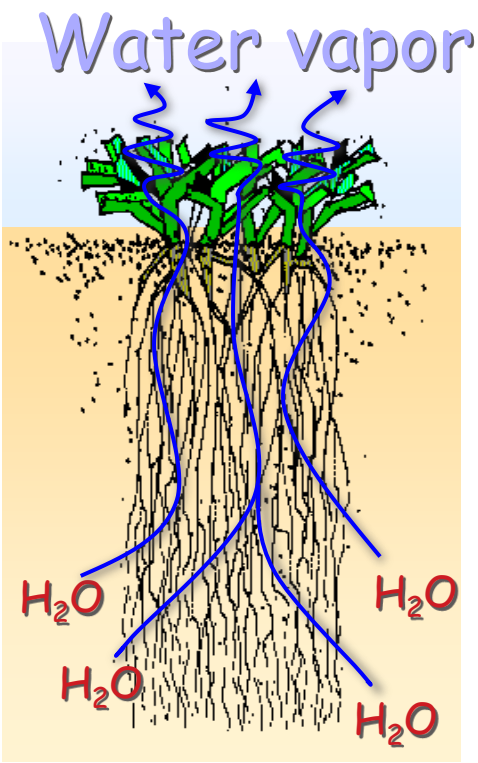
WATER USE

- Water for irrigation is becoming increasingly limited. Poses a challenge for turfgrass managers and homeowners to:
  1. Become more efficient with irrigation
  2. Utilize strategies to reduce irrigation (ie. Improve soil, species, aeration, remove turf)
  3. Consider alternative water sources
  4. Lower expectations

CALCULATING PLANT WATER USE

- Transpiration + evaporation= EVAPOTRANSPIRATION (ET)

- Factors affecting ET
  - Solar radiation
  - Grass species
  - Humidity
  - Temperature
  - Wind

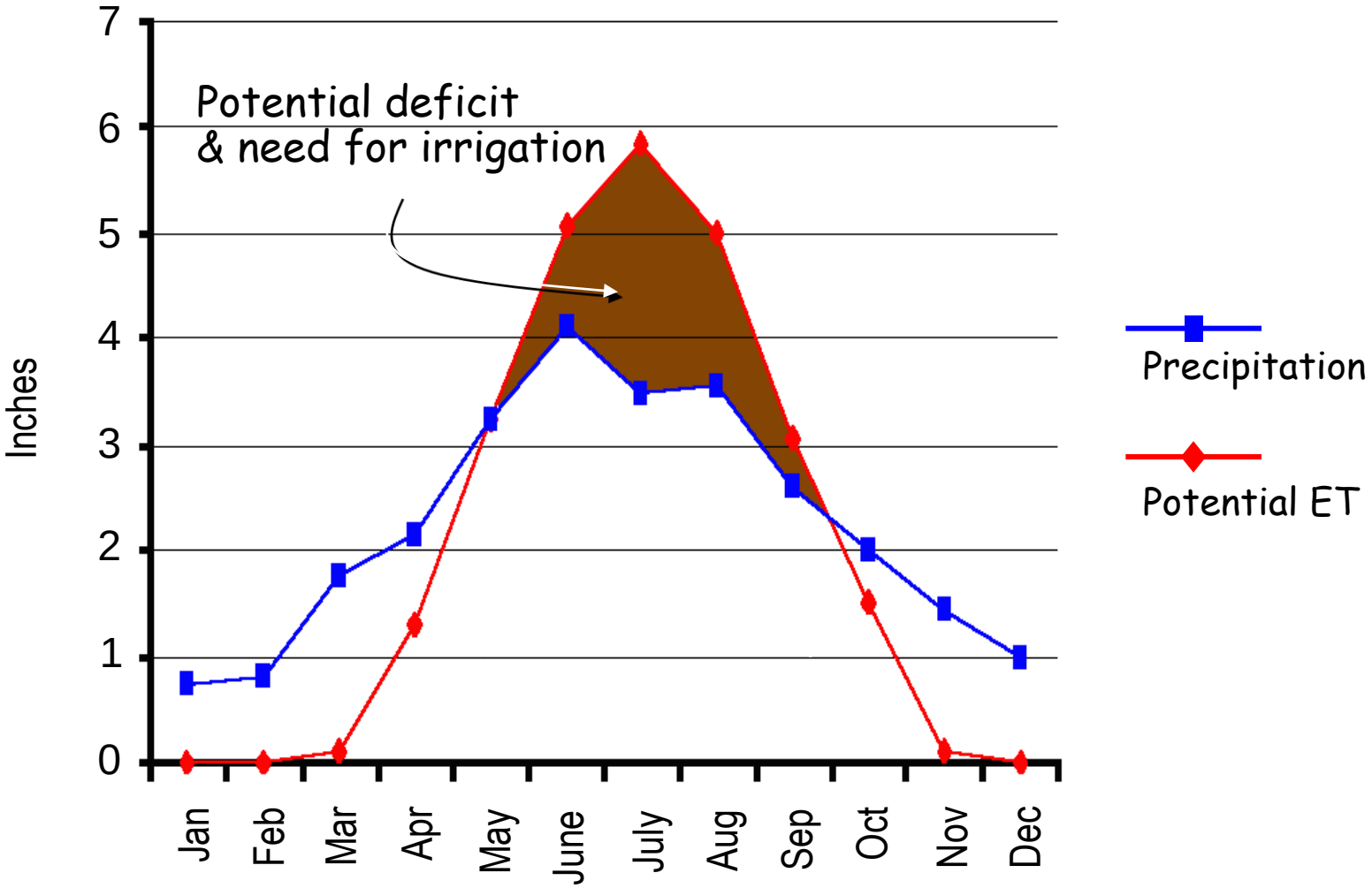


Dr. Van Cline, The Toro Co.

WHY IS ET IMPORTANT?

ET estimates give us a **quantifiable** reference in deciding how much water to apply, addressing the fundamental questions of **volume** and **frequency**

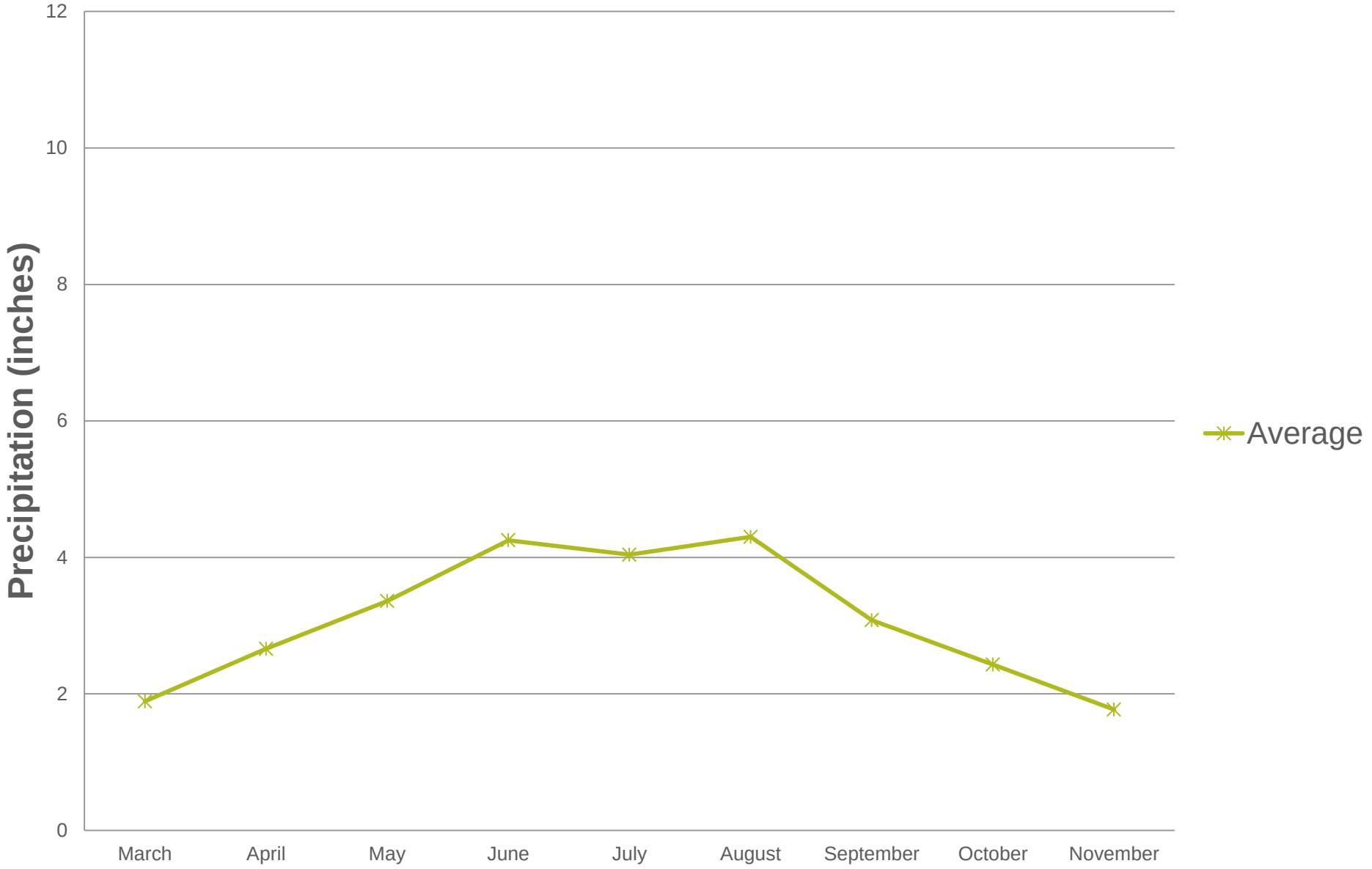
Average Precipitation vs. Potential Evapotranspiration (ET)



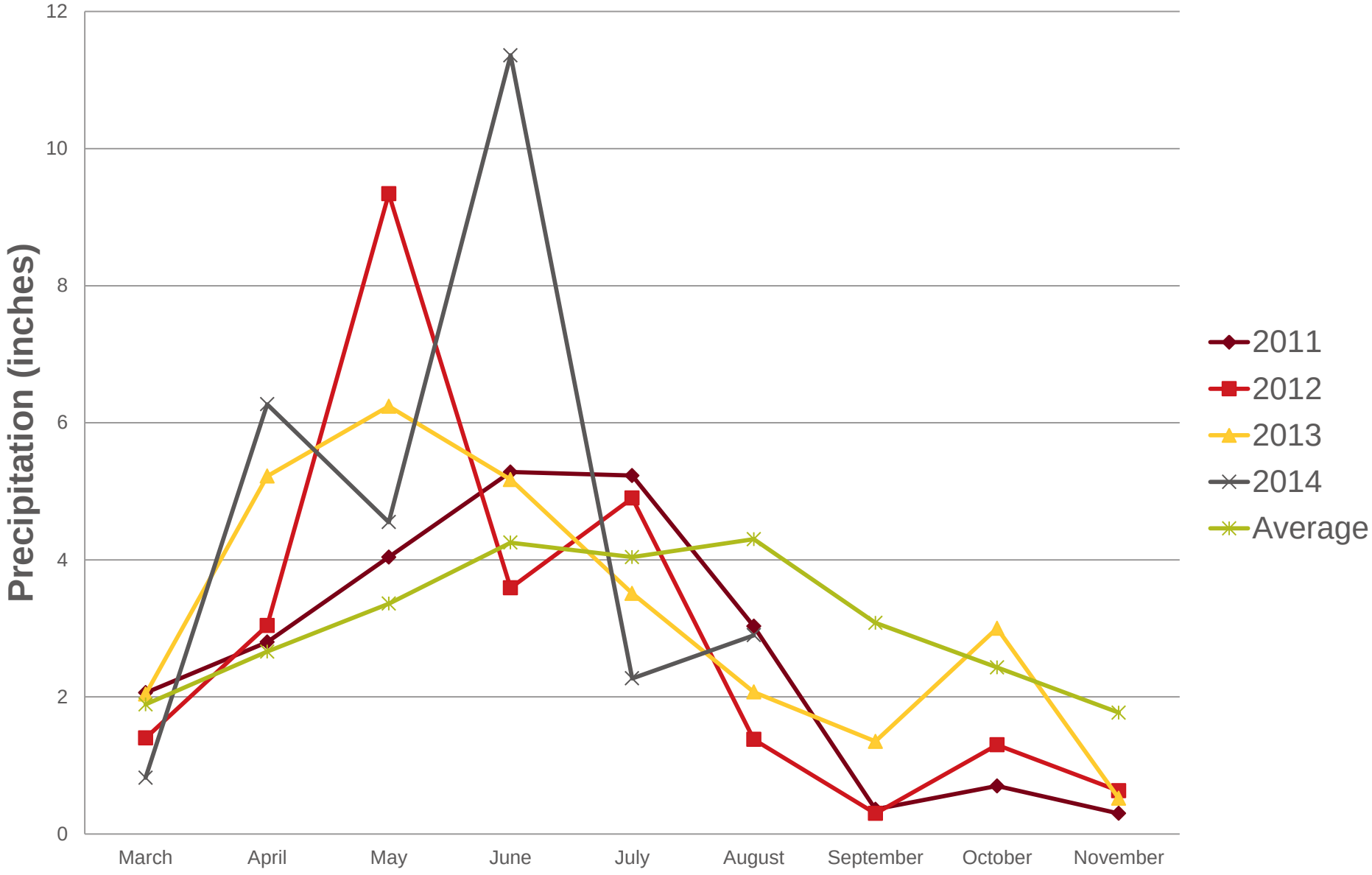
Minneapolis, St. Paul

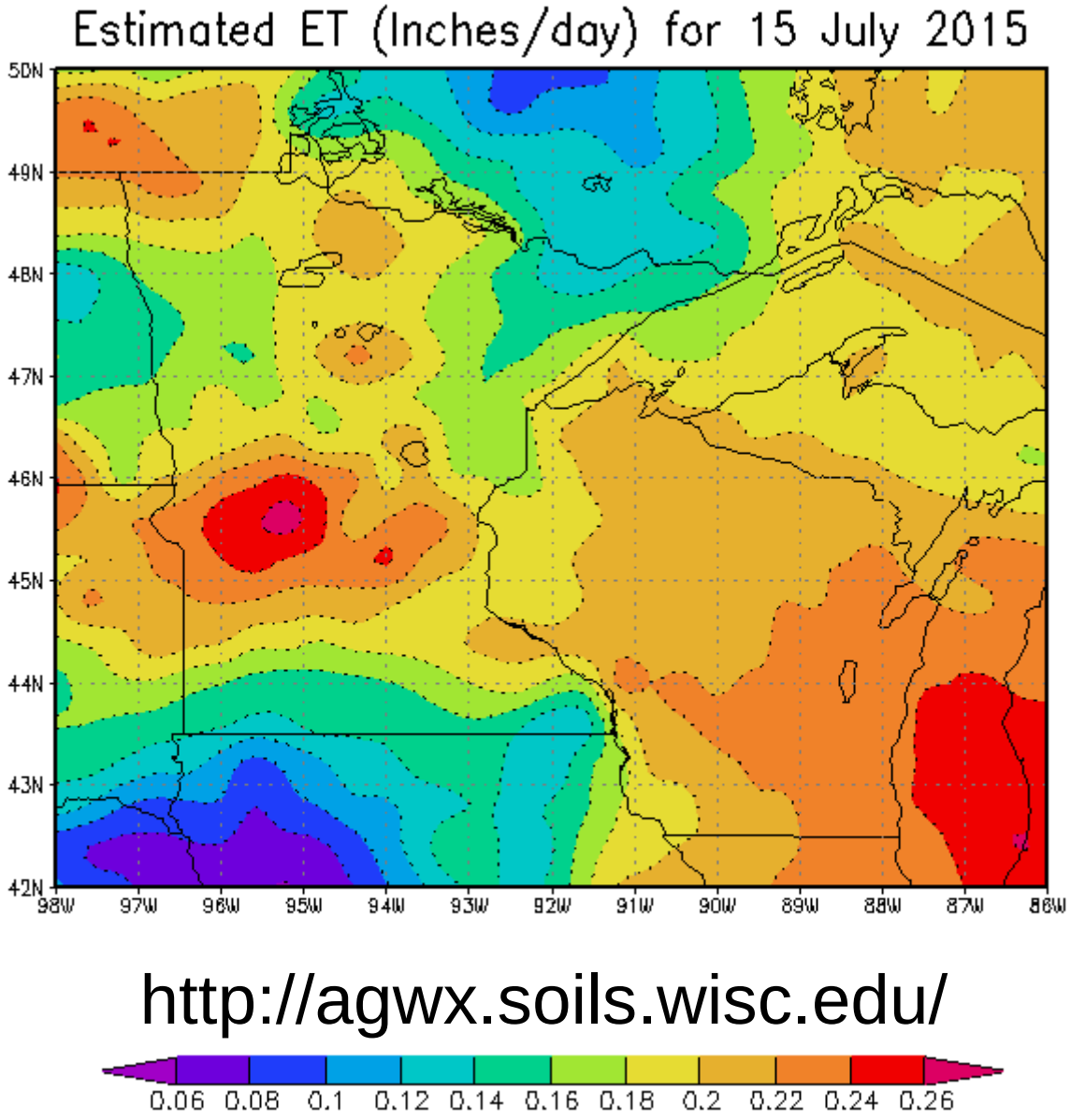
Slide: Dr. Van Cline, The Toro Co.

Minneapolis/St. Paul Rainfall



Minneapolis/St. Paul Rainfall





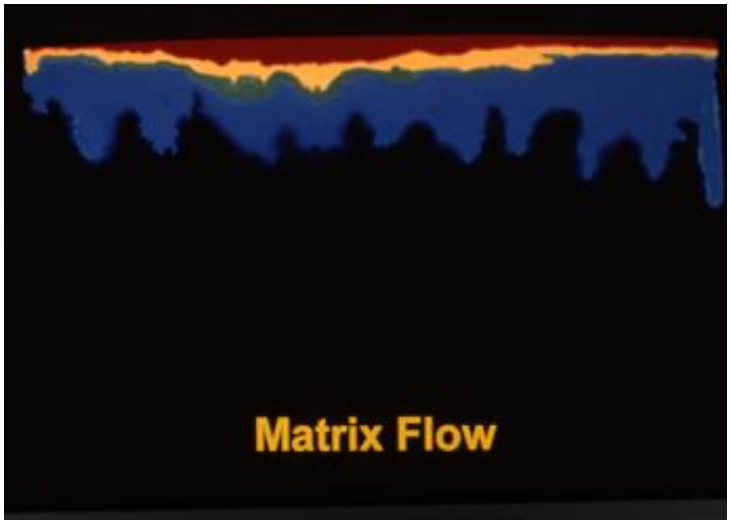
http://agwx.soils.wisc.edu/

Soil moisture dynamics

SOIL MOISTURE DYNAMICS

Irrigation or Rainfall

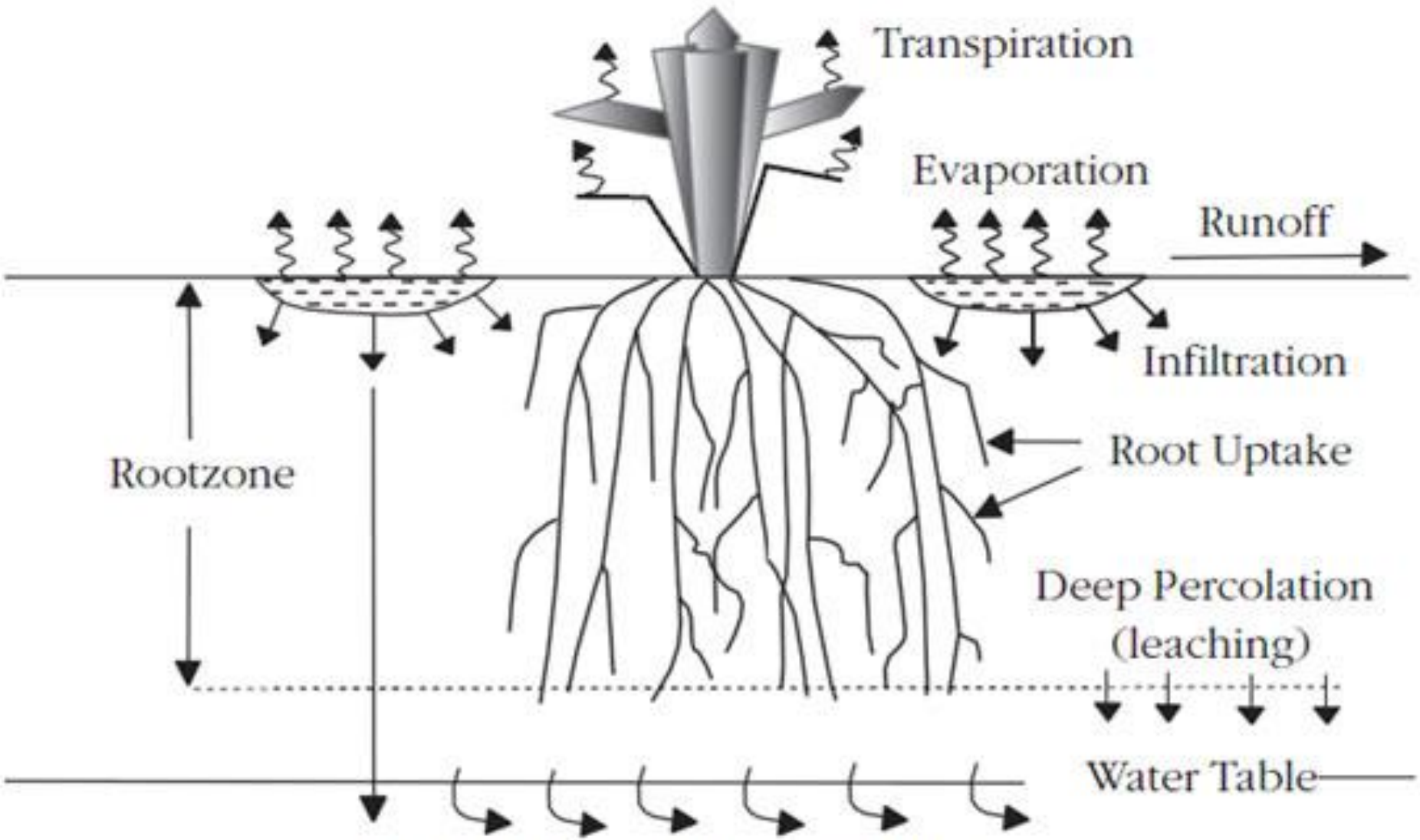
Infiltrate



M. Petrovic et al., Cornell University

Run off

Fate of Water Applied to the Turfgrass Rootzone

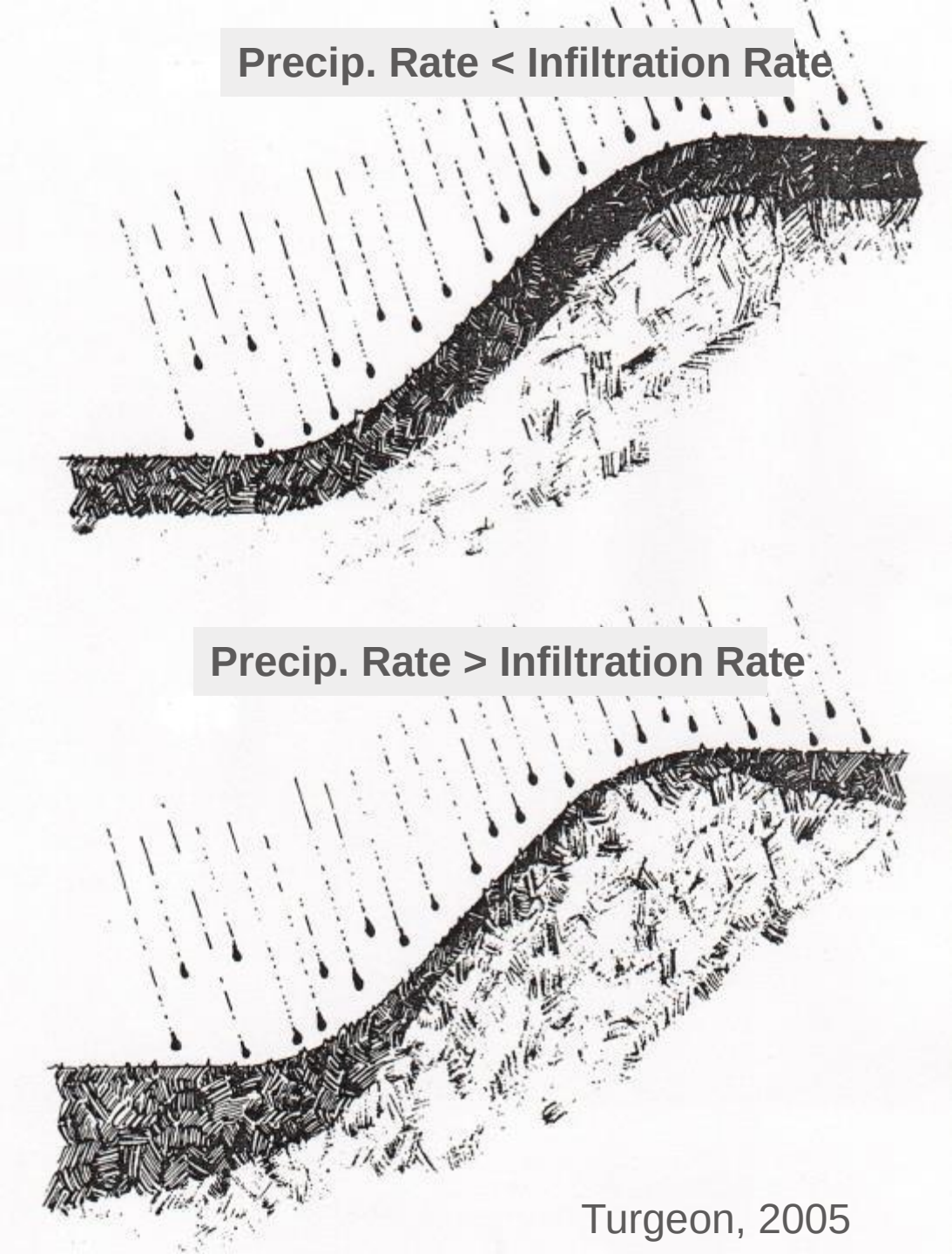


SOIL MOISTURE DYNAMICS

Infiltration rate and fate of water are influenced by:

- Soil texture (particle size)
  - Sand, silt, clay
- Soil structure (arrangement of soil aggregates)
  - Granular, platy, prismatic, sub-angular blocky
- Pore space and size
- Soil moisture status
  - Saturation, field capacity, permanent wilting point
- Compaction
- Topography
  - Slope, aspect, depressions

Precipitation and Infiltration Rates



Turgeon, 2005

SOIL WATER INFILTRATION

Soil Infiltration Rates (in/hour)	
Coarse sand	1.0 and up
Fine sand	0.5 to 3.1
Sandy loam	0.4 to 2.6
Loam	0.08 to 1.0
Clay loam	0.04 to 0.6
Clay	0.01 to .10

Adapted from: Kopec, 1995

SOIL WATER HOLDING CAPACITY

Soil Texture	Available Water Capacity (Inches/Foot of Depth)
Sand	0.6 – 1.00
Sandy loam	1.25 – 1.40
Silt loam	2.00 – 2.50
Clay	1.20 – 1.50

Dr. Doug Soldat, UW-Madison

Irrigation- how much, how often, when and how

HOW MUCH WATER DOES TURF NEED?

- 0.5”/week
- 1.0”/week
- 2”/week

DEPENDS!!!!

VARIABLES TO CONSIDER FOR IRRIGATION

- Environmental conditions (ET)
  - Temperature, wind speed, rainfall, humidity, etc.
- Function and expectations
- Grass species and variety
- Soil type and organic matter
  - Sand = less water holding, high infiltration
  - Clay = greater water holding, low infiltration
- Present turf conditions
  - Compacted
  - Seasonal weather fluctuations


Campus Shuttle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TURFGRASS
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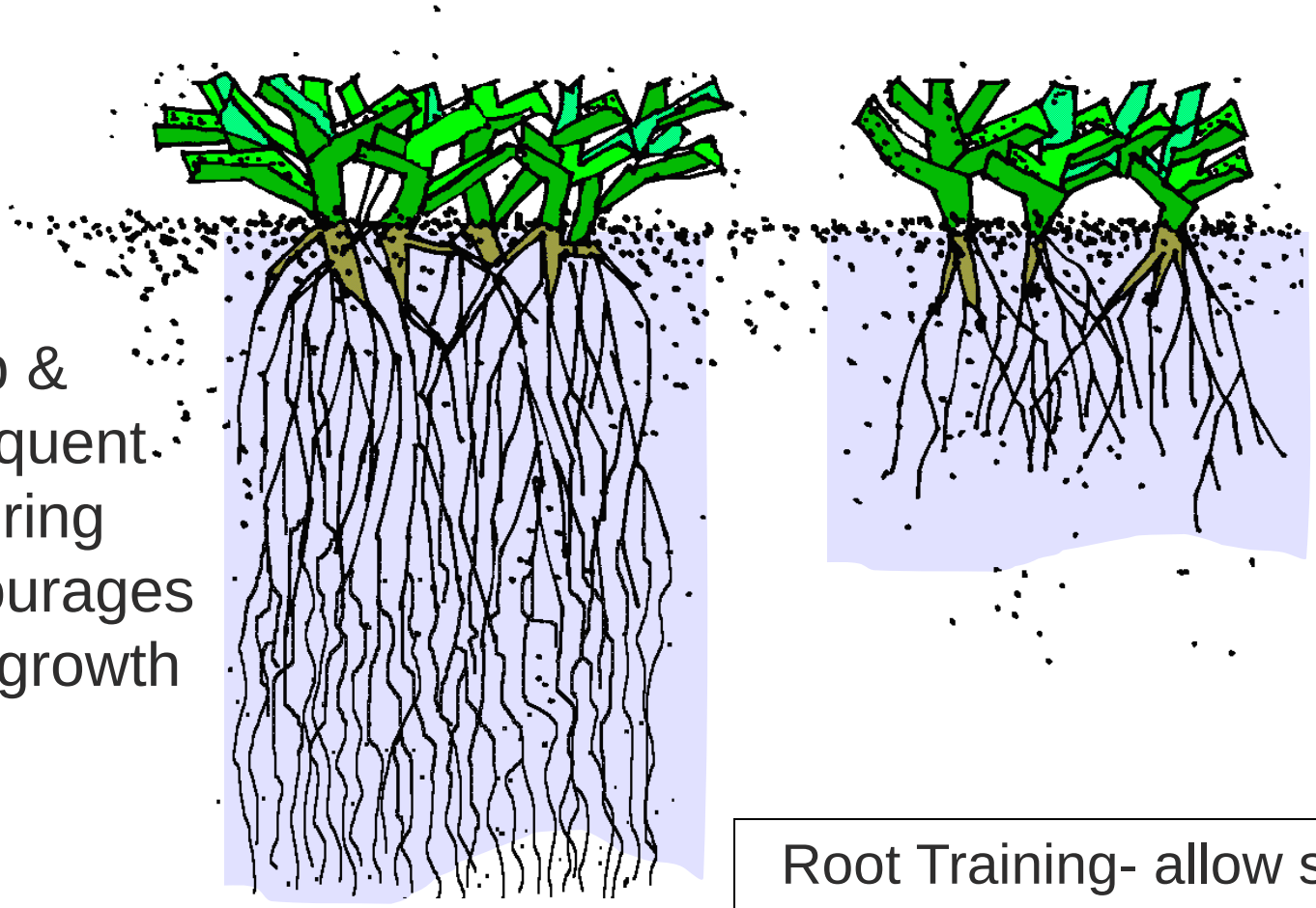
italladdsup.umn.edu/livinglab

IRRIGATION FREQUENCY

- Once a day or once a week?
  - As infrequent as possible while still maintaining the health desired
  - Wet the soil to sufficient depths with each irrigation
    - Possibly 0.5 to 1” to reach soil depths of 6” and greater (soil type dependent)
  - Utilize multiple cycles per night for soils with low infiltration
  - Increase frequency and reduce volume in summer, or let lawns go dormant

Irrigation Strategies

deep & infrequent watering encourages root growth



shallow & frequent watering trains the grass to require that

Root Training- allow soils to dry to near wilt before the next cycle

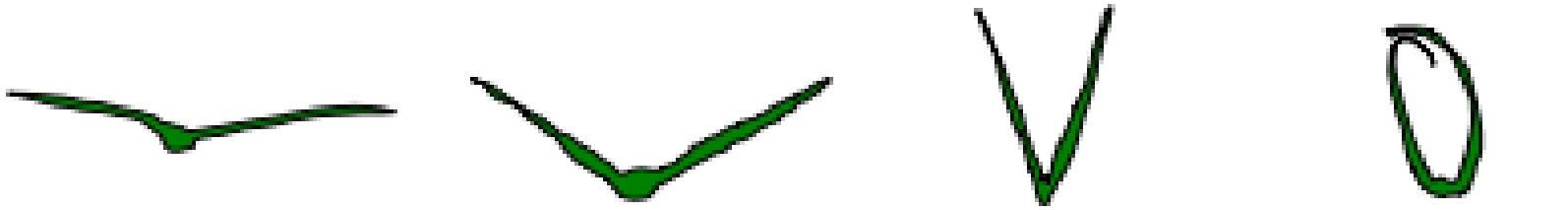
IRRIGATION TIMING

- Irrigate in early morning if possible. During breakfast or before you leave for work.
  - Daytime irrigation is less efficient
    - Evaporation losses
    - Wind
  - Late afternoon to late evening irrigation can increase the incidence of certain turfgrass diseases, weeds, and promote succulence

DETERMINING WHEN TO WATER

- Soil moisture probe

Effect of Water Status on Appearance of Leaf Cross Section

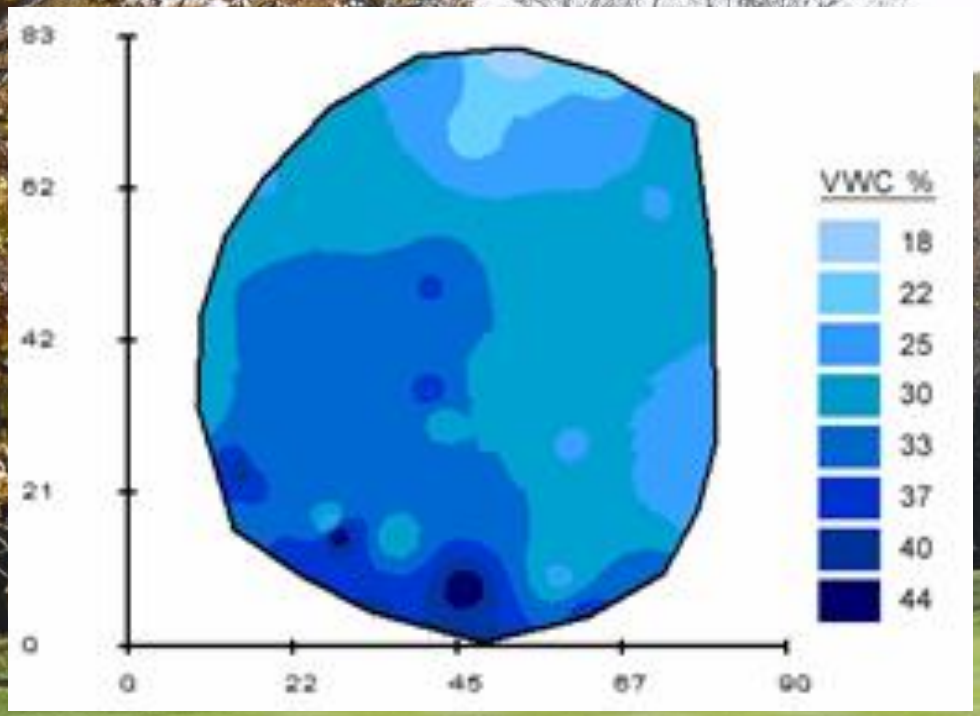


Dr. Dave Gardner, Ohio State

Dr. Aaron Patton, Purdue


Karl Danneberger, Ohio State University

Portable measurements



SETTING IRRIGATION OBJECTIVES BY EXPECTATIONS: LAWNS

- High maintenance lawns
  - Irrigate as much as needed to promote green color and healthy turf. Deep and infrequent strategy.

- Medium maintenance lawns
  - Irrigate to prevent dormancy during the summer months, some browning is acceptable

- Low maintenance lawns
  - No irrigation, summer dormancy is acceptable; repair may be needed following extended periods of hot, dry conditions

SUMMER DORMANCY

- During drought periods with no irrigation available turfgrass shoot growth ceases; both shoots and roots can die back (i.e., summer dormancy – the ability of a plant to avoid hot / dry conditions by ceasing growth)

- Buds in the crowns, stolons, and rhizomes normally survive and initiate new growth when favorable temperature and moisture conditions return


7/26/07

8/28/07

SETTING IRRIGATION OBJECTIVES BY SEASON: SPORTS

- Spring
  - Spring rains generally provide adequate moisture ,and plant demands are low. Irrigate infrequently to promote rooting. Light frequent irrigations may be required to germinate seed
- Summer
  - Increase frequency and reduce volumes to account for receding root systems. Afternoon syringing may be required
- Fall
  - Transition back to infrequent applications. Do not push turf past the point of wilt. Focus on healthy turf going into winter

SETTING IRRIGATION OBJECTIVES BY SURFACE TYPE: GOLF

- Putting greens
  - Generally deep and infrequent throughout the growing season. Species with shorter root systems might require irrigation more frequently, especially in the summer. Utilize handwatering and syringing
- Tees
  - Greater frequency to germinate seed in divots and promote recovery
- Fairways
  - As infrequent as possible to maintain health and promote color
- Rough
  - Similar program as fairways in immediate rough. Dormancy accepted on some rough

EFFECTIVE IRRIGATION IS THE FOCUS

- Effective irrigation:
  - When all water that's applied is consumed by the turf; none lost through runoff, deep percolation, evaporation, system efficiencies
  - Maximum effectiveness implies relative uniformity in plant available soil moisture

- Effective irrigation is a function of:
  - Irrigation system or sprinkler performance (uniform distribution)
  - Site conditions- when water leaves the nozzle site conditions determine its ***fate*** – where it ends up and whether or not it's effective

IRRIGATION UNIFORMITY

- Basic concept behind irrigation uniformity is to apply water as evenly as possible
  - Most irrigation scheduling is driven by dry spots
  - Applying more water to dry spots over-irrigates everything else
  - Decreasing the difference between minimum and maximum wetness is the goal

IRRIGATION UNIFORMITY

IRRIGATION AUDITING PROCEDURES

1. Site inspection
   - Check irrigation components, arcs and angles, programs
2. Performance testing
   - Catch cans. Longer test times = greater accuracy
   - Calculate precipitation rate and distribution uniformity
3. Scheduling
   - Set specific run times for each zone

DISTRIBUTION UNIFORMITY (DU)

- Measure by setting out several water collection cups on a grid
- DU = avg of lower 25% (lower quartile) divided by overall average of collection cups

Dr. Doug Soldat, UW-Madison

Table 13.1. Turfgrass and landscape sprinkler system field audit performance rankings by distribution uniformity and sprinkler type[a]

Sprinkler type (typical use)	Distribution uniformity (DU_{LQ}) and expected system performance				
	Excellent (achievable)	Very good	Good (expected)	Fair	Poor (needs improvement)
Multiple-stream gear and impact rotors (golf and large turfgrass areas)	85%	80%	75%	65%	55%
Single-stream gear and impact rotors (medium-sized landscape and turfgrass areas)	75%	70%	65%	60%	50%
Fixed-spray heads (small lawns and landscapes)	70%	65%	55%	50%	40%

[a] Developed by Cal Poly Irrigation Training and Research Center at California State Polytechnic University, San Luis Obispo. Funded by California Department of Water Resources and the Metropolitan Water District of Southern California. Adapted from Walker et al. 1988.

Beard and Kenna, 2008

Catch can volumes (in)

1.1	0.80
1.1	0.78
1	0.76
0.99	0.72
0.98	0.72
0.92	0.7
0.88	0.68
0.85	0.6
0.82	0.54
0.80	0.5

1 hour run time

Overall average = 0.812
Lower quartile average = 0.604

0.604 / 0.812 * 100 = 74.4%

Distribution uniformity = 74.4%

Precipitation rate = 0.812”/hr

IRRIGATION ZONE ADJUSTMENTS

$$\text{Zone run time (min)} = \frac{\text{Targeted irrigation depth (in.)}}{\text{Zone precip rate (in./hr)}} \times 60$$

$$\text{Zone run time (min)} = \frac{0.5 \text{ inches}}{0.81 \text{ inch/hr}} \times 60$$

37 minutes to apply 0.5 inches of irrigation

CONTROLLER TECHNOLOGIES

Smart controllers:

- Store historical data
- Onsite sensors for calculating real time ET
- Actual weather station utilization for ET adjustment
- Rainfall, temperature, and moisture sensors

www.hunterindustries.com

www.cyber-rain.com

ADD-ONS

- Soil moisture sensors

- Rain sensors
  - The bare minimum

www.toro.com

www.rainbird.com

www.rainbird.com

Strategies to reduce water use

STRATEGIES TO REDUCE WATER USE

- Auditing irrigation systems
- Install rain sensors on automated systems, better yet- turn it off
- Deep and infrequent watering
- Drought tolerant species and varieties
- Raise mowing heights
- Reduce mowing frequency
- Soil aeration

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COOL-SEASON TURF SPECIES THAT MEET PUBLIC EXPECTATIONS IN MN

- Kentucky bluegrass
  - Most common species in MN, high quality, high maintenance
- Perennial ryegrass
  - Included in many seed mixtures, quick establishment, high maintenance, poor winter hardiness
- Fine fescue species
  - Fine texture, low maintenance, component of no-mow mixtures
- Tall fescue
  - Coarser texture, low maintenance, drought avoidant
- Bentgrasses
  - Used mostly on golf courses, generally higher maintenance

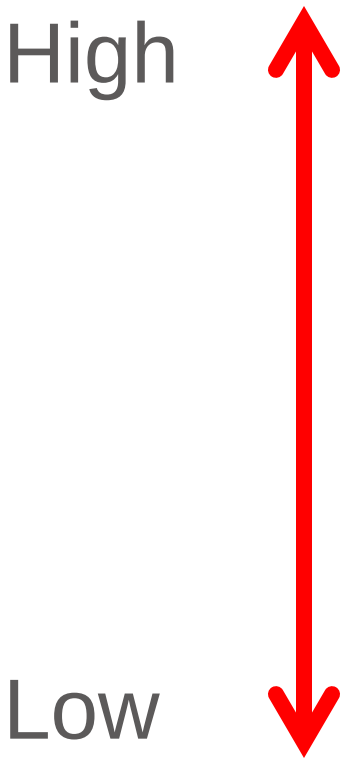
FINE FESCUES

- *Uses*: home lawns, parks, golf course fairways
- *Positives*
  - Low fertility needs
  - Slow-growing
  - Shade or sun
  - Drought tolerance
- *Negatives*
  - Disease under wear
  - Snow mold

TALL FESCUE
FESTUCA ARUNDINACEA

- *Uses:* home lawns, athletic fields, golf course roughs, parks
- *Positives*
  - Drought avoidant
  - Wear tolerant
  - Disease resistant
- *Negatives*
  - Not winter hardy under ice cover
  - Does not mix well

DROUGHT RESISTANCE OF TURFGRASSES



Tall fescue

Fine fescue

Best recommendation for balancing low maintenance with average expectations

Kentucky bluegrass

Perennial ryegrass

Creeping bentgrass

Turgeon, 2005

DROUGHT RESISTANCE

Drought resistance = avoidance + tolerance

1. Drought avoidance
   - Deep/extensive root system, thick cuticle, small stomata openings, dormancy, escape
   - Tall fescue (deep roots), Kentucky bluegrass (dormancy), annual bluegrass (escape)
2. Drought tolerance
   - Ability to tolerate drought and survive desiccation, low water users
   - Fine fescues, buffalograss

WATER USE RATES

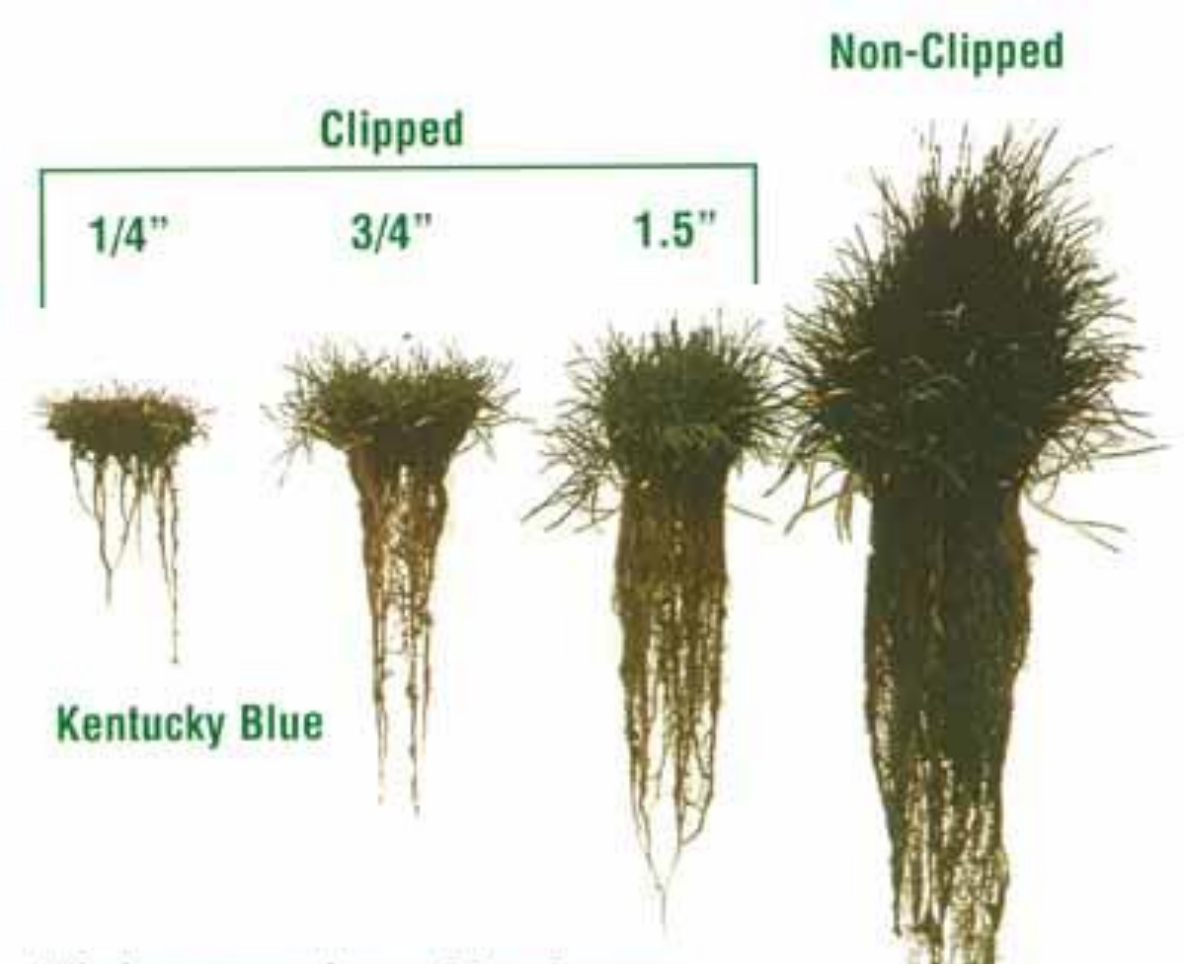
Species	Approx. Max. ET Rate[1]
Buffalograss	< 0.25”
Fine fescue	0.25”
Kentucky bluegrass	0.35”
Tall fescue	0.40”

[1] In a well-watered condition with optimum temperature for growth

Modified from Beard and Beard (2004)

DEFICIT IRRIGATION

- The practice of irrigating turfgrass at rates below the calculated water loss
- Many studies show that irrigation rates at less than 100% ET replacement do not result in loss of quality or function



Mowing height affects rooting depth and irrigation requirements

Image: www.atlasturf.com

Mowing Intervals (in days) to Remove no more than 1/3 Top Growth

	Desired height (in.)	Mow at	Growth rate (in./day) .1	.2	.3
	**1.0**	**1.5**	**5**	**2.5**	**1.7**
	**2.0**	**3.0**	**10**	**5**	**3**
	**3.0**	**4.5**	**15**	**7.5**	**5**

OTHER MANAGEMENT PRACTICES

- Nitrogen fertilization- increased growth and greater ET rates
  - Balance fertility with irrigation to reduce water
- Aeration increases rooting and water infiltration
  - Combine with the addition of compost or organic matter for sand and clay soils to improve moisture holding capacity.

Management Practices to Mitigate Nutrient Transport with Runoff

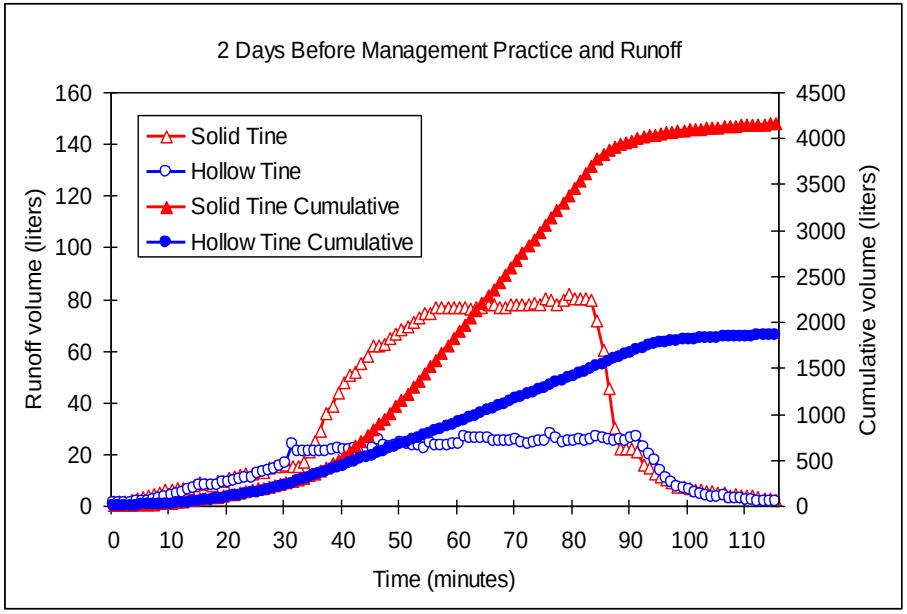
Solid Tine Aeration

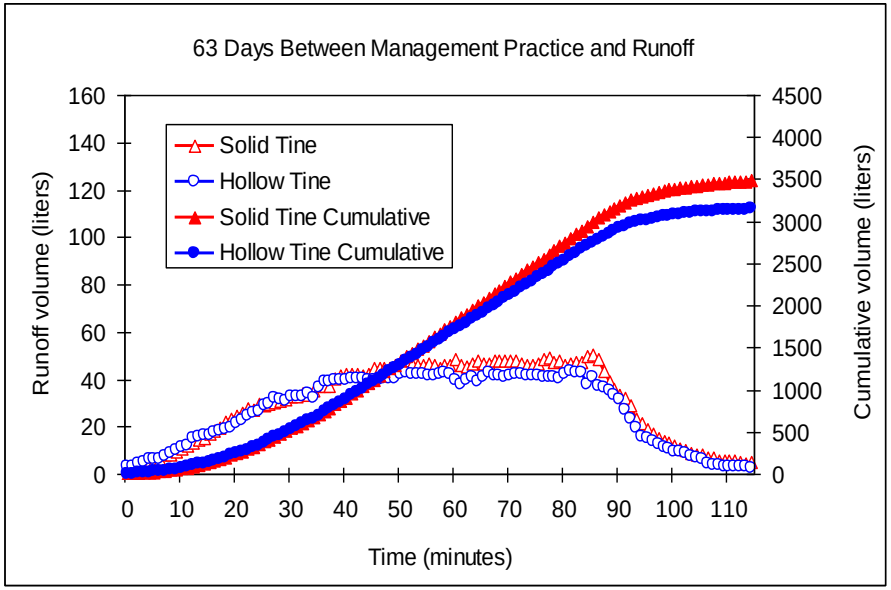
vs.

Hollow Tine Aeration

Hollow vs. Solid Tine Aerification

Reduced Runoff Volumes with Hollow Tine





Runoff volume

- 55% reduction with hollow tine aerification (2 d)
- 10% reduction with hollow tine aerification (63 d)

SUMMARY

- Water use is one of the biggest challenges facing the turfgrass management and lawn care
- Soil type has a huge influence on plant available water
- The frequency and volume of irrigation depend on many factors; be sure to consider all of them
- Be thorough with irrigation system auditing
- Consider drought tolerant species and cultural practices to reduce water use
- Aeration practices have the ability to significantly affect the amount of water that leaves a site.
  - This can ultimately affect the efficiency of every irrigation cycle or rainfall event

ADDITIONAL INFORMATION

- UMN Turfgrass Science Website: www.turf.umn.edu
- UMN Extension Turfgrass Management Website: www.extension.umn.edu/turfgrass
- Sustainable Urban Landscape Information Series: www.sustland.umn.edu

Yard and Garden Info:

- Facebook: “University of Minnesota Yard and Garden”
- Twitter: @urbanturfmn and @UMNyardgarden
- Blog: http://blog.lib.umn.edu/efans/ygnews/

Smart Gardens Radio Show WCCO AM830, Saturdays 8-9am

Sam contact: 763-767-3518, sjbauer@umn.edu