Program Outline

Having a healthy lawn while using less water is possible. It starts with making the right choices of plant material and management practices.

Turfgrass Selection

Select the best variety for your location and needs

Watering, Mowing, Feeding

Management practices to increase drought hardiness, improve quality, reduce water use

Dealing with Growing Pains

What to do when turfgrass is not practical

Texas Water Resources Institute

Turfgrass Selection

Right Plant; Right Place:
Match turfgrass to meet your needs, expectations, and location

Warm season turfgrass traits

Table 3. Relative traits of warm-season turfgrass species when grown in their regions of adaptation with good maintenance programs and adequate rainfall or irrigation ("range" indicates varietal differences).

Trait	Bermudagrass	Buffalograss	Centipede	Seashore Paspalum	St. Augustine	Zoysiagrass
Shade Tolerance	Very Low to Low	Low	Moderate	Low	High	Moderate to High
Water Requirement	Moderate to Low	Very Low	Moderate	Moderate	Moderate	Moderate
Drought Tolerance	Very Good to Excellent	Excellent	Moderate	Good	Good	Very Good
Traffic Tolerance	High	Low	Low	Moderate to High	Low	Moderate to High
Cold Tolerance	Moderate	High	Low	Low	Low	Moderate to High
Salinity Tolerance	Moderate to High	Low	Low to Moderate	Moderate to Very High	Good	Moderate to High
Disease Potential	Low to Moderate	Low	Low to Moderate	Low to Moderate	High	Low to Moderate
Mowing Height *(inches)*	0.75 to 4.0	2 to not Mowed	1.5 to 2.0	0.75 to 2.0	2.0 to 5.0	0.75 to 4.0
Leaf Texture	Fine	Fine	Coarse	Fine	Coarse	Medium to Fine
Stolons *(S)* and/or Rhizomes *(R)**	S&R	S	S	S&R	S	S&R

*Turfgrasses with stolons (i.e., aboveground stems) can grow laterally. Turfgrasses with rhizomes (i.e., underground stems) can also grow laterally.

Texas Water Resources Institute
make every drop count

Sunlight Requirement

5 hours of good sunlight for strong healthy warm-season turfgrass

- St Augustinegrass is the best option for shade
- Raise mower blades in shade
- Water less

Sunlight Requirement	Species
High (8 -10 hr minimum)	Bermudagrass
	Bahiagrass
	Centipedegrass
	Zoysiagrass (*Z. japonica*)
	Zoysiagrass (*Z. matrella*)
Low (4 – 6 hr minimum)	St. Augustinegrass

St. Augustinegrass

- Common
- Raleigh
- Palmetto
- DelMar
- Scotts ProVista
- Floratam
- Amerishade
- FJ Select
- Cobalt

Bermudagrass

- Common
- Celebration
- Latitude 36 (TAMU)
- North Bridge
- Tahoma 31 (UARK)
- Tifway 419
- TifTuf (TCU)
- Ironcutter

Zoysiagrass

- Palisades
- JaMur
- Meyer*
- Innovation
- Zeon
- Zorro
- Cavalier

Buffalograss

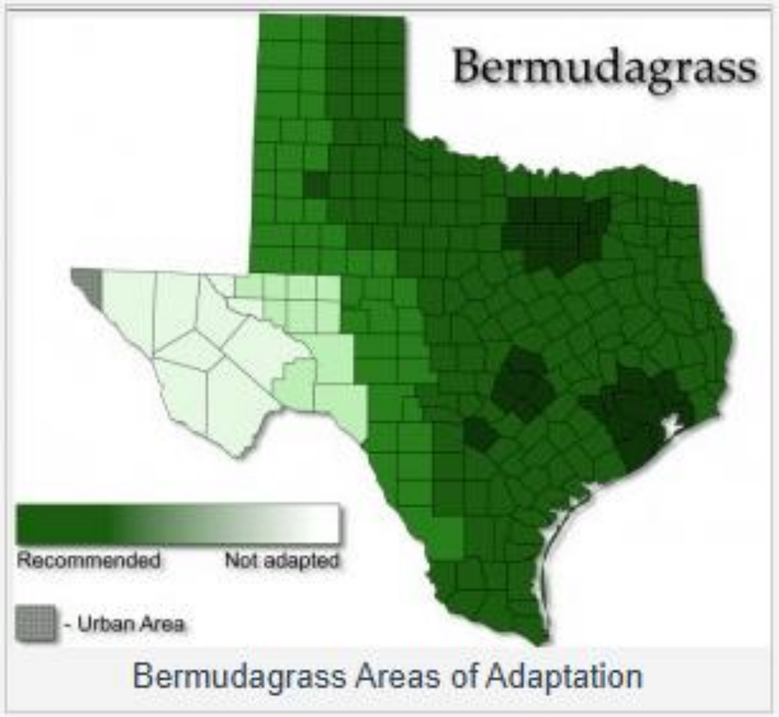
- Density
- Prestige
- Prairie
- 609

texasgrass.com

Texas Water Resources Institute
make every drop count

Bermudagrass

- Not tolerant of shade
- Tolerant of salinity, drought, foot traffic
- Requires higher rates nitrogen fertilizer
- Suited to athletic fields, golf course fairways, and higher maintenance lawns



Bermudagrass Areas of Adaptation

https://aggieturf.tamu.edu/texas-turfgrasses/bermudagrass/

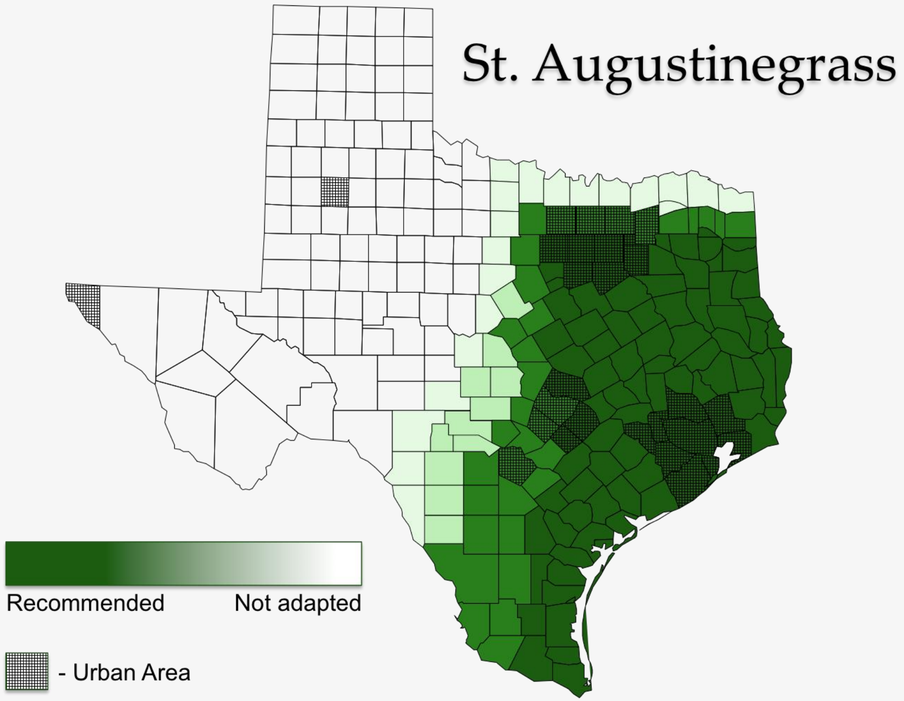
Bermudagrass Varieties Available in Texas

Vegetatively Propagated Varieties

Variety	Latin Name	Availability
Baby	*Cynodon dactylon* (L.) Pers.	Sod
Celebration	*Cynodon dactylon* (L.) Pers.	Sod/Sprigs
GN-1	Cynodon dactylon (L.) Pers.	Sod/Sprigs
Discovery	Cynodon dactylon (L.) Pers.	Sod/Sprigs
Grimes EXP	Cynodon dactylon (L.) Pers.	Sod/Sprigs
Latitude 36	*Cynodon dactylon* (L.) Pers. x *Cynodon transvaalensis* Burtt Davy	Sod/Sprigs
Midiron	*Cynodon dactylon* (L.) Pers. x *Cynodon transvaalensis* Burtt Davy	Sod/Sprigs
Northbridge	*Cynodon dactylon* (L.) Pers. x *Cynodon transvaalensis* Burtt Davy	Sod/Sprigs
Patriot	*Cynodon dactylon* (L.) Pers. x *Cynodon transvaalensis* Burtt Davy	Sod/Sprigs
Premier	*Cynodon dactylon* (L.) Pers.	Sod/Sprigs
Quickstand	*Cynodon dactylon* (L.) Pers.	Sod/Sprigs
Texas Native	*Cynodon dactylon* (L.) Pers.	Sod/Sprigs
Texas Turf 10	*Cynodon dactylon* (L.) Pers.	Sod/Sprigs
Tifton 10	*Cynodon dactylon* (L.) Pers.	Sod/Sprigs
TifGrand	*Cynodon dactylon* (L.) Pers. x *Cynodon transvaalensis* Burtt Davy	Sod/Sprigs
Tifsport	*Cynodon dactylon* (L.) Pers. x *Cynodon transvaalensis* Burtt Davy	Sod/Sprigs
TifTuf	*Cynodon dactylon* (L.) Pers. x *Cynodon transvaalensis* Burtt Davy	Sod/Sprigs
Tifway II	*Cynodon dactylon* (L.) Pers. x *Cynodon transvaalensis* Burtt Davy	Sod/Sprigs
Tifway 419	*Cynodon dactylon* (L.) Pers. x *Cynodon transvaalensis* Burtt Davy	Sod/Sprigs
U3	*Cynodon dactylon* (L.) Pers.	Sod/Sprigs

St. Augustinegrass

- Superior shade tolerance
- Good drought tolerance
- Deep rooting potential
- Fast establishment



St. Augustinegrass Varieties Available in Texas		
Variety	**Latin Name**	**Availability**
Amerishade	*Stenotaphrum secundatum* (Walt.) Kuntze	Sod
Captiva	*Stenotaphrum secundatum* (Walt.) Kuntze	Sod
Common	*Stenotaphrum secundatum* (Walt.) Kuntze	Sod
Delmar	*Stenotaphrum secundatum* (Walt.) Kuntze	Sod
Deltashade	*Stenotaphrum secundatum* (Walt.) Kuntze	Sod
Floratam	*Stenotaphrum secundatum* (Walt.) Kuntze	Sod
Mercedes	*Stenotaphrum secundatum* (Walt.) Kuntze	Sod
Palmetto	*Stenotaphrum secundatum* (Walt.) Kuntze	Sod
Raleigh	*Stenotaphrum secundatum* (Walt.) Kuntze	Sod
~~TamStar~~	~~*Stenotaphrum secundatum* (Walt.) Kuntze~~	~~Sod~~

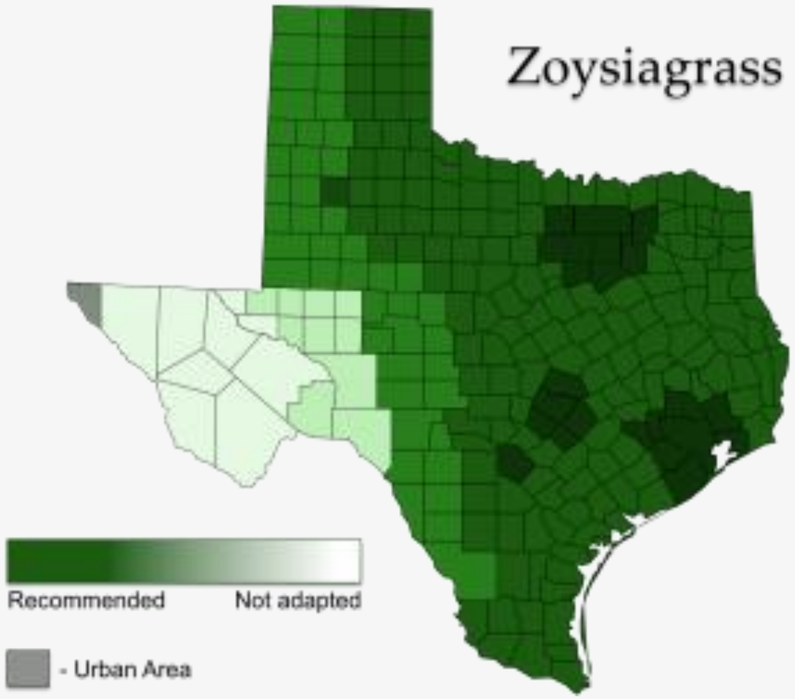
Cobalt Hybrid *Stenotaphrum secundatum* ***Sod***

https://aggieturf.tamu.edu/texas-turfgrasses/st-augustinegrass/

https://cobaltstaugustine.com/

Zoysiagrass

- Drought tolerance
- Cold tolerance
- Shade tolerance
- Good traffic tolerance
- Low fertilization requirement
- Susceptible to thatch
- Slow recovery
- Finer textured species have less drought tolerance

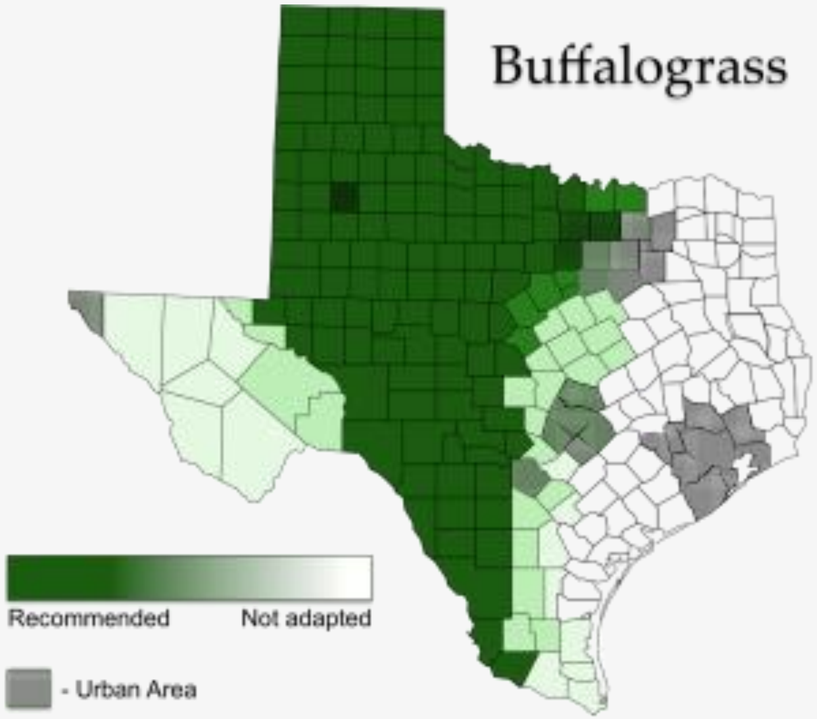


https://aggieturf.tamu.edu/texas-turfgrasses/zoysiagrass/

Zoysiagrass Varieties Available in Texas		
Variety	Latin Name	Availability
Carrizo	*Zoysia japonica* Steud.	Sod
Cavalier	*Zoysia japonica* Steud. x *Zoysia matrella* (L.) Merr.	Sod
Chinese Common	*Zoysia japonica* Steud.	Seed
Compadre	*Zoysia japonica* Steud.	Seed/Sod
Crowne	*Zoysia japonica* Steud. x *Zoysia matrella* (L.) Merr.	Sod
Cutlass	*Zoysia japonica* Steud.	Sod
Diamond	*Zoysia matrella* (L.) Merr.	Sod
El Toro	*Zoysia japonica* Steud. x *Zoysia matrella* (L.) Merr.	Sod
Emerald	*Zoysia japonica* Steud. x *Zoysia pacifica* (Goudswaard) M. Hota & Kuroki	Sod
Empire	*Zoysia japonica* Steud. x Zoysia *matrella* (L.) Merr.	Sod
Geo	*Zoysia japonica* Steud. x *Zoysia tenuifolia* Willd. Ex Thiele	Sod
Jamur	*Zoysia japonica* Steud. x *Zoysia matrella* (L.) Merr.	Sod
Meyer	*Zoysia japonica* Steud.	Sod
Palisades	*Zoysia japonica* Steud. x *Zoysia matrella* (L.) Merr.	Sod
Pristine Flora	*Zoysia matrella* (L.) Merr.	Sod
Royal	*Zoysia japonica* Steud. x *Zoysia matrella* (L.) Merr.	Sod
Ultimate Flora	*Zoysia matrella* (L.) Merr.	Sod
Y-2	*Zoysia japonica* Steud. x *Zoysia matrella* (L.) Merr.	Sod
Zenith	*Zoysia japonica* Steud.	Seed/Sod
Zeon	*Zoysia japonica* Steud. x *Zoysia matrella* (L.) Merr.	Sod
Zorro	*Zoysia japonica* Steud. x *Zoysia matrella* (L.) Merr.	Sod

Buffalograss

- Drought tolerance
- Cold tolerance
- Low disease potential
- Low fertilization requirement
- Low mowing requirement
- Poor shade tolerance
- Weed encroachment
- Poor traffic tolerance



Buffalograss Varieties Available in Texas		
Variety	**Latin Name**	**Availability**
609	(*Bouteloua dactyloides* (Nutt.) J.T. Columbus)	Seed/Sod
Bison	(*Bouteloua dactyloides* (Nutt.) J.T. Columbus)	Seed
Bowie	(*Bouteloua dactyloides* (Nutt.) J.T. Columbus)	Seed
Cody	(*Bouteloua dactyloides* (Nutt.) J.T. Columbus)	Seed
Density	(*Bouteloua dactyloides* (Nutt.) J.T. Columbus)	Sod
Plains	(*Bouteloua dactyloides* (Nutt.) J.T. Columbus)	Seed
Prairie	(*Bouteloua dactyloides* (Nutt.) J.T. Columbus)	Sod
Prestige	(*Bouteloua dactyloides* (Nutt.) J.T. Columbus)	Sod
Sundancer	(*Bouteloua dactyloides* (Nutt.) J.T. Columbus)	Seed
Texoka	(*Bouteloua dactyloides* (Nutt.) J.T. Columbus)	Seed
Top Gun	(*Bouteloua dactyloides* (Nutt.) J.T. Columbus)	Seed

https://aggieturf.tamu.edu/texas-turfgrasses/zoysiagrass/

ET-Based Deficit Irrigation Study

Study Methods:

- Planted June 2022 as sod in Dallas, TX
- Clay soil (pH 8.2-8.4)
- Mowing height 3.0" (2023) and 4.5" (2024)
- Randomized complete block design with 4 reps, and 4 irrigation treatments

Adjustment Factor:

- 0.8 = low stress
- 0.6 = moderate stress
- 0.5 = high stress
- 0.4 = severe stress

Texas Water Resources Institute
make every drop count

Chase Martin, Ambika Chandra, Pablo Boeri, Guy Fipps, Charles Swanson
Texas A&M AgriLife Research and Extension

ET-Based Deficit Irrigation Study

Results

Turfgrass Cultivar	Low Stress (0.8 Af)		Moderate Stress (0.6 Af)		High Stress (0.5 Af)		Severe Stress (0.4 Af)	
	2023	2024	2023	2024	2023	2024	2023	2024
Cobalt	Acceptable	Acceptable	91	94	70	80	56	50
Raleigh	98	58	56	42	43	30	34	23
TifTuf	Acceptable	Acceptable	83	65	56	42	48	50
Tifway	98	58	56	42	43	42	34	35
Palisades	Acceptable	100	56	58	43	50	34	35

Days of acceptable turfgrass quality (≥6) under irrigation levels in 2023 and 2024. 'Acceptable' indicates no decline below rating of 6.

- Cobalt and TifTuf maintained acceptable quality in the 0.8 Af treatment both years
- On average, Cobalt held TQ 44 days longer than Raleigh; TifTuf 25 days longer than Tifway (moderate stress)
- High Stress: Cobalt 39 days longer than Raleigh; TifTuf 7 days longer than Tifway
- Severe Stress: Cobalt 25 days longer than Raleigh; TifTuf 14 days longer than Tifway
- With drought tolerance like this, lawn owners can conserve more water

Texas Water Resources Institute
make every drop count

Chase Martin, Ambika Chandra, Pablo Boeri, Guy Fipps, Charles Swanson
Texas A&M AgriLife Research and Extension

Water My Yard Verification Project and Water Savings Potential

In total, 91 scorecards were collected. Scorecard analysis showed most attendees found the turfgrass varieties in the 60% Af treatment to be Acceptable to Highly Acceptable, having an overall average score of 3.20. Table 3 provides a summary of the WaterMyYard Field Day scorecard responses.

Table 3. WaterMyYard Field Day Scorecard Summary

Treatment, Af	Average Rating (1-4 Scale)	Total Rating Responses; n=1,792			
		Unacceptable	Possibly Acceptable	Acceptable	Highly Acceptable
40%	2.68	30	146	211	62
50%	2.97	12	103	220	113
60%	3.20	11	64	195	177
80%	3.57	2	28	131	287

Figure 9. Homeowners rating the field plots at the WaterMyYard Field Day.

- Cobalt and TifTuf maintain an acceptable TQ longer than Raleigh and Tifway with ~35-38% less water
- On average, a homeowner in Dallas, TX with a 4,500 ft^2 lawn can save ~3,300 gallons of water during summer
- Ten sub-divisions of 50 homes could save around **1.7 Million** gallons of water

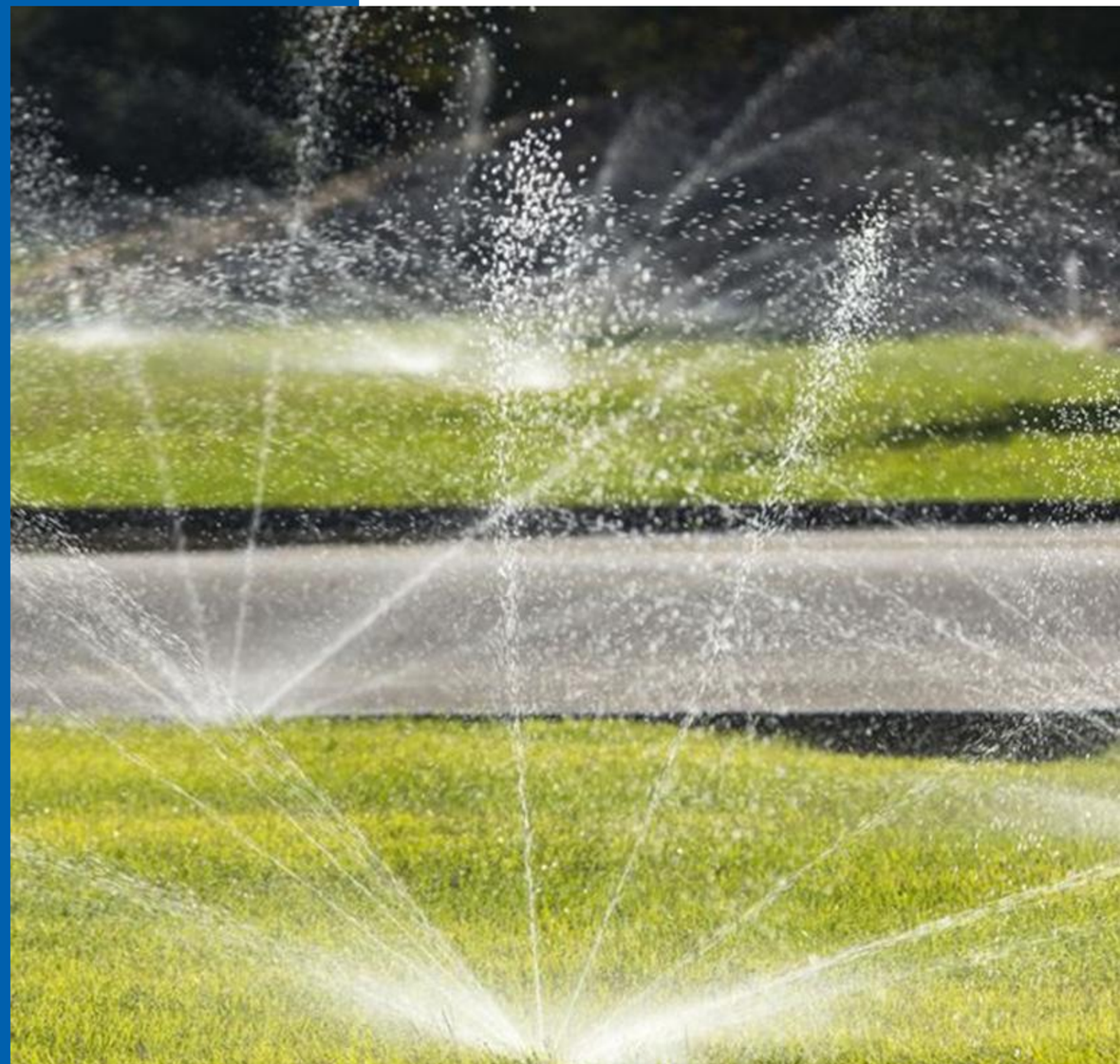
Texas Water Resources Institute
make every drop count

Chase Martin, Ambika Chandra, Pablo Boeri, Guy Fipps, Charles Swanson
Texas A&M AgriLife Research and Extension

Texas Water Resources Institute

Management

- ❑ Watering
- ❑ Mowing
- ❑ Fertilizing
- ❑ Compost amendments
- ❑ Grass clippings

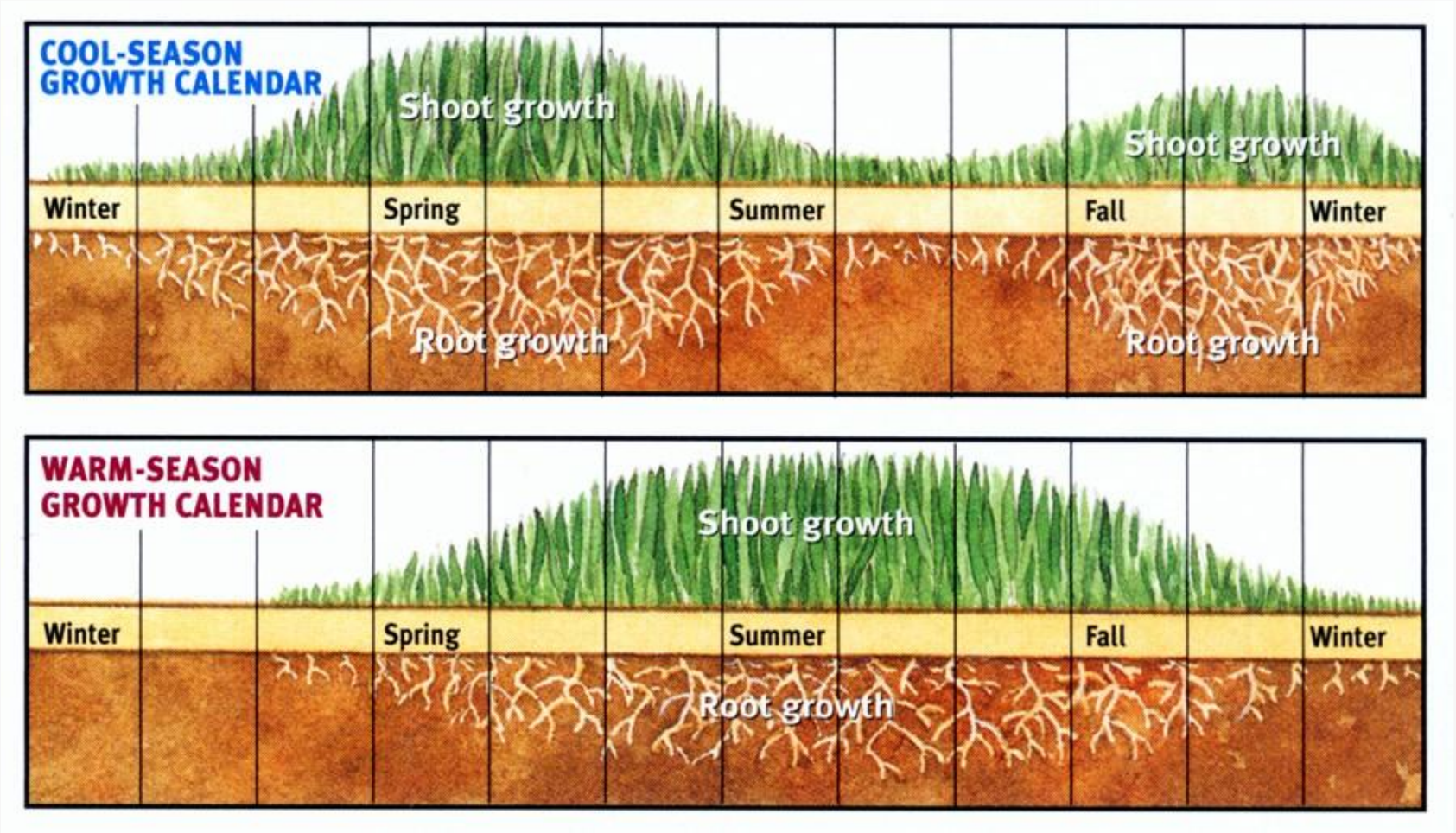


Drought Avoidance

Turfgrass cultivars rely on deep roots to support a drought mechanism called drought avoidance.

Critical rooting for drought resistance may occur anywhere **between 6 and 24 inches** based on research for new and upcoming cultivars.

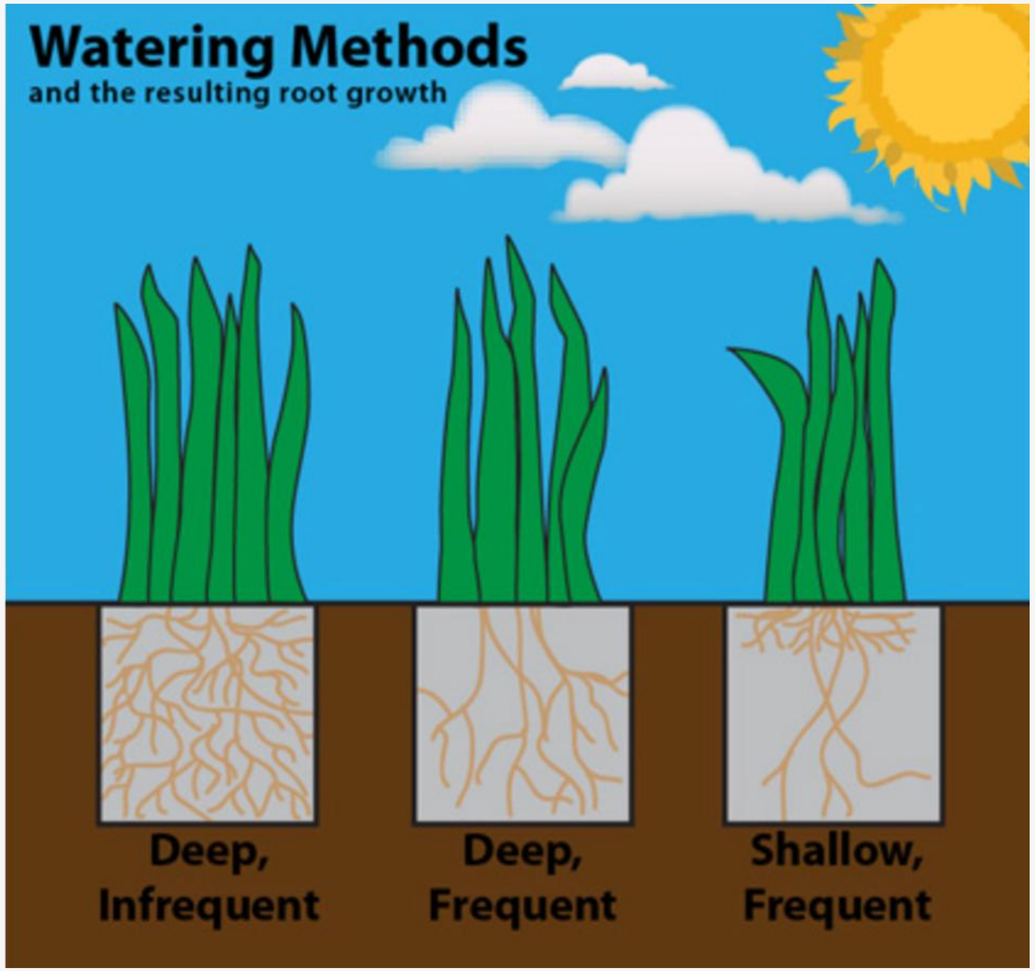
WARM SEASON VS. COOL SEASON TURFGRASS



Irrigation Timing

Water Deeply and Infrequently

Promotes deeper rooting which improves turfgrass tolerance to stresses like drought and traffic



txsmartscape.com/

Texas Water Resources Institute
make every drop count

Irrigation Timing

Cycle and Soak Scheduling

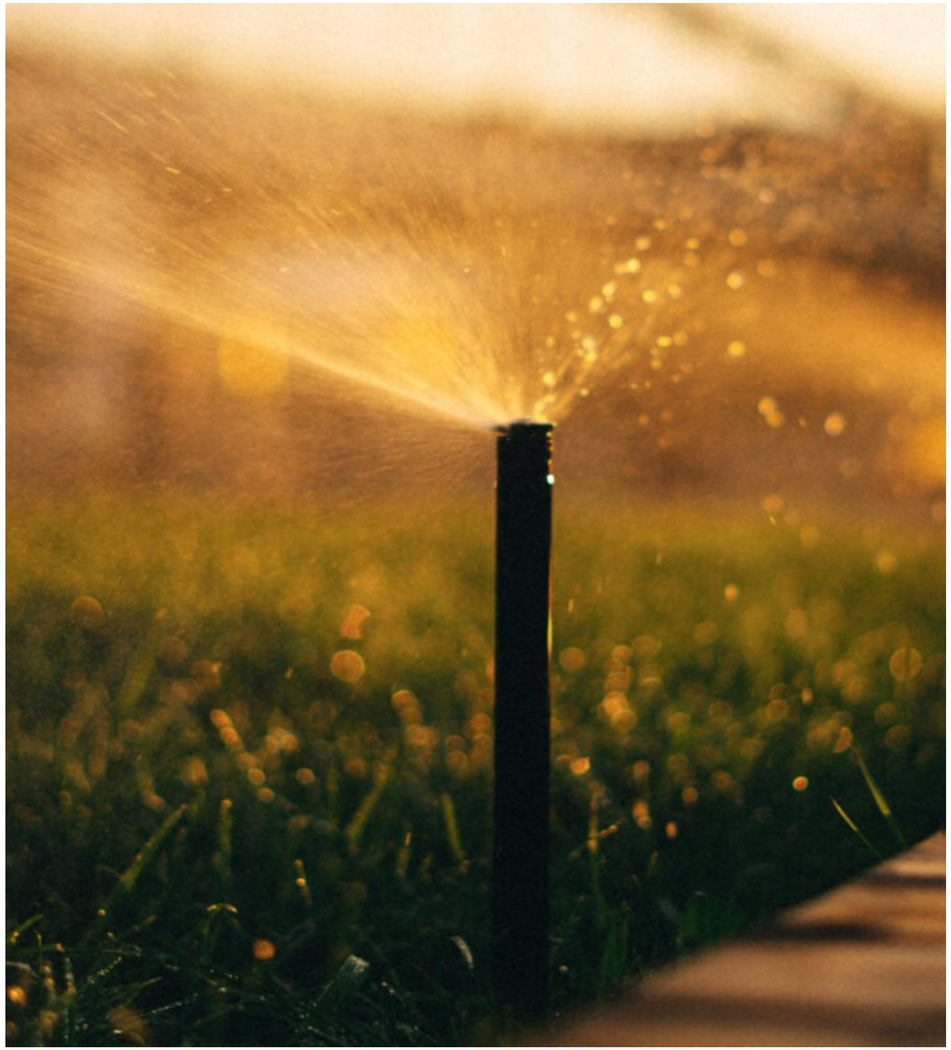
- Breaks down the weekly watering time into smaller waterings
- Allows more water to be captured by the soil
- Helps to meet local watering regulations
- Minimizes runoff

Texas Water Resources Institute
make every drop count

Irrigation Timing

Early Morning Watering is Ideal

Avoid watering between 10am to 6pm when the temperature and winds are higher.



Texas Water Resources Institute
make every drop count

Cycle and Soak Scheduling

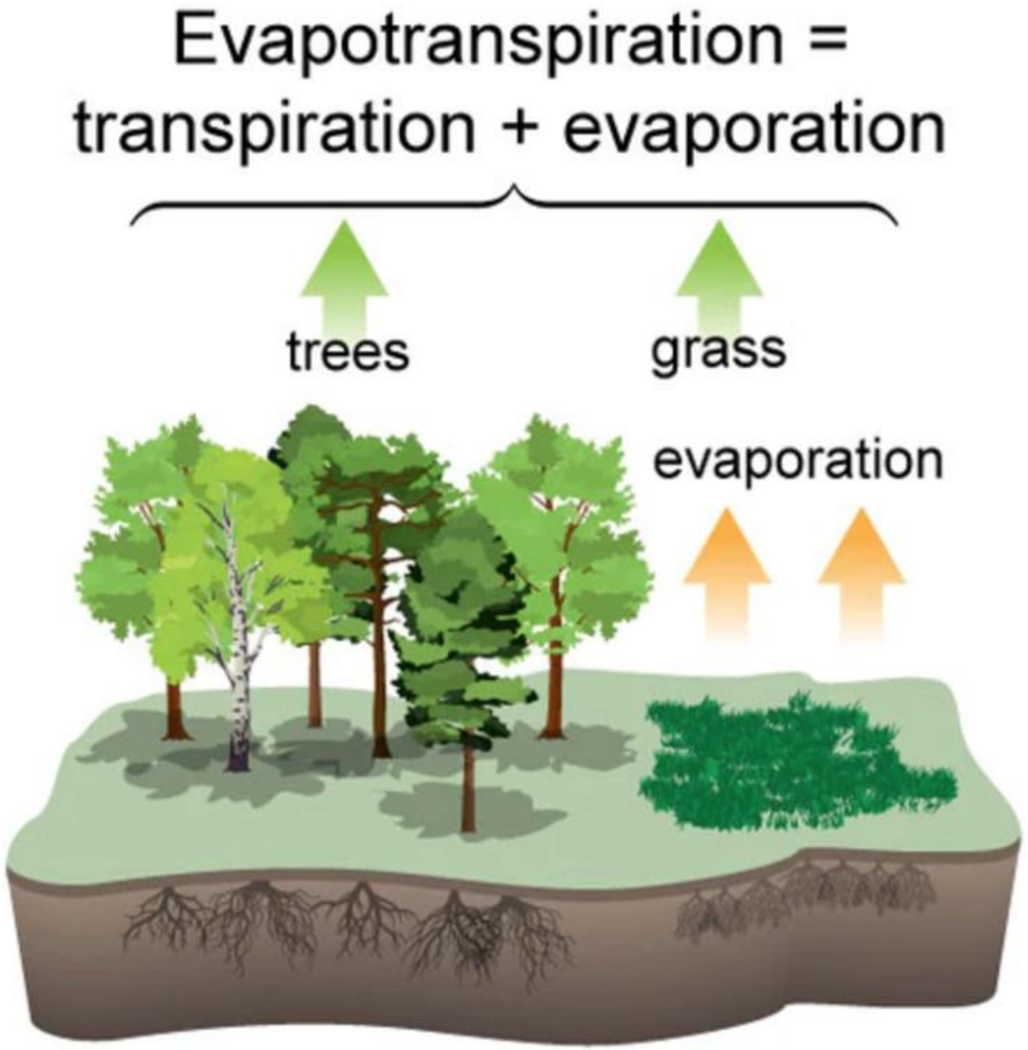
Short Run Times

Made up of multiple cycles for each zone with 30-60 minutes for the water to **soak** in before the next **cycle** starts.

- First cycle breaks the surface tension of the soil saturating the top layer.
- Second cycle infiltrates the soil more efficiently and move water deeper into the soil.
- Third cycle, and fourth, if necessary, works well with slopes or if runoff occurs after just a few minutes of irrigation.

Cycle and Soak Example Schedule

Original Schedule	Start Time 1	Start Time 2	Start Time 3	Start Time 4
	2 a.m.			
Zone 1 (Sprays) Front Yard Turf	15 Minutes			
Zone 2 (Sprays) Side Yard Turf	12 Minutes			
Zone 3 (Drip) Front Yard Flower Bed	30 Minutes			
Zone 4 (Rotors) Backyard Turf	40 Minutes			
Total Run-Time	97 Minutes			
New Cycle and Soak Schedule (2 Cycles)				
	2 a.m.	3 a.m.		
Zone 1 (Sprays) Front Yard Turf	7	7		
Zone 2 (Sprays) Side Yard Turf	6	6		
Zone 3 (Drip) Front Yard Flower Bed	15	15		
Zone 4 (Rotors) Backyard Turf	20	20		
Total Run-Time		96 Minutes		
New Cycle and Soak Schedule (3 Cycles)				
	2 a.m.	3 a.m.	4 a.m.	
Zone 1 (Sprays) Front Yard Turf	5 Minutes	5 Minutes	5 Minutes	
Zone 2 (Sprays) Side Yard Turf	4 Minutes	4 Minutes	4 Minutes	
Zone 3 (Drip) Front Yard Flower Bed	10 Minutes	10 Minutes	10 Minutes	
Zone 4 (Rotors) Backyard Turf	13 Minutes	13 Minutes	13 Minutes	
Total Run-Time			96 Minutes	



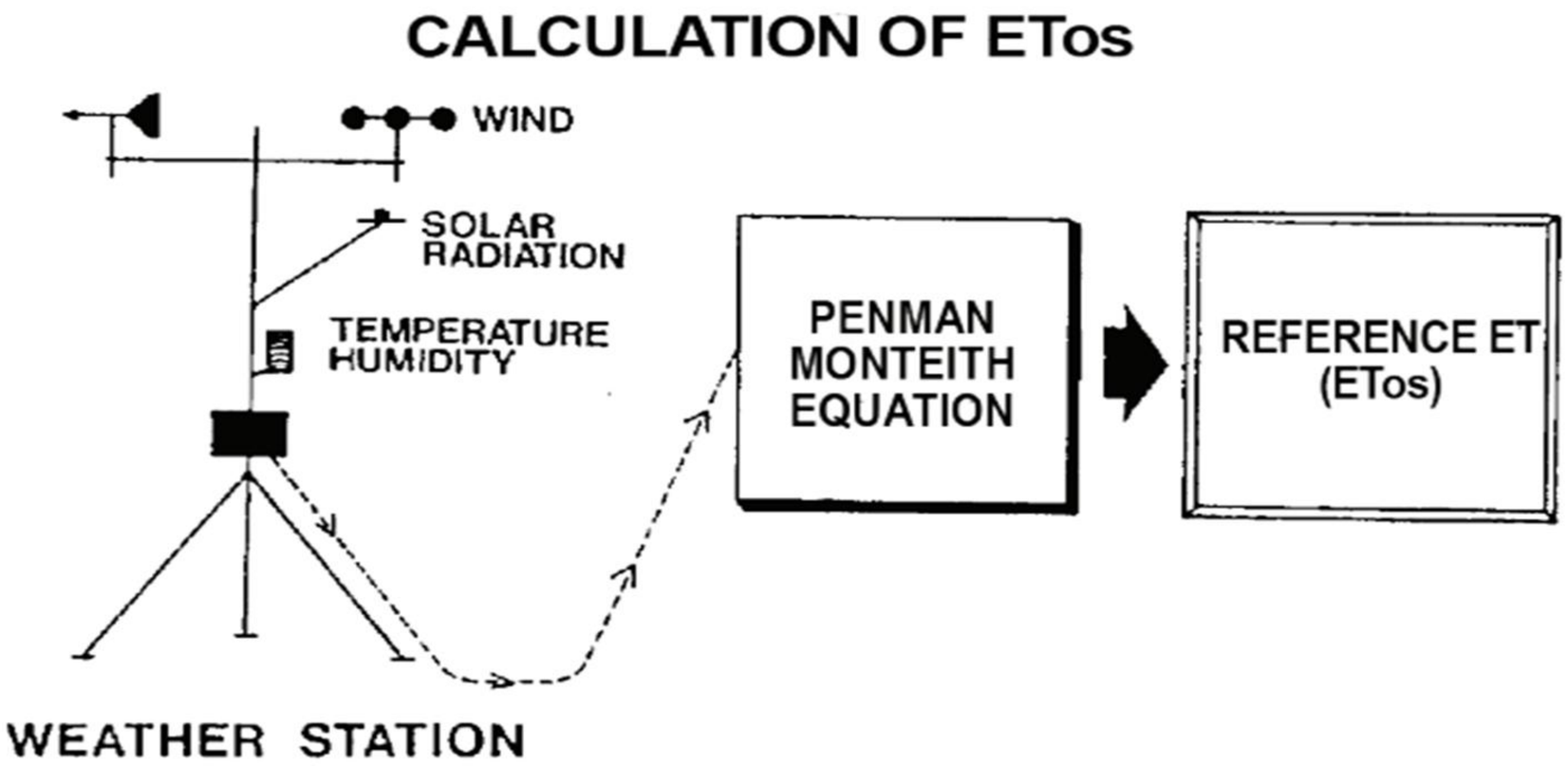
How do we determine

Turfgrass Water Needs?

Evapotranspiration is the sum of all processes by which water moves from the land surface to the atmosphere via evaporation and transpiration.

Texas Water Resources Institute
make every drop count

Evapotranspiration



Texas Water Resources Institute
make every drop count

Texas Water Resources Institute
make every drop count

General Plant Coefficients

Plant type	Plant factor (PF)*/ Crop coefficient (K_c)†
Landscape plants with high water use	0.7–0.9*
Landscape plants with medium/moderate water use	0.4–0.6*
Landscape plants with low water use	0.1–0.3*
Landscape plants with very low water use	< 0.1*
Warm-season turfgrass (Bermudagrass, zoysiagrass, St. Augustinegrass, buffalograss)	0.6†
Cool-season turfgrass (tall fescue, Kentucky bluegrass, ryegrass, bentgrass)	0.8†

Plant factors (PF)/crop coefficients (K c) for established landscape plants in California

Warm-season turfgrass coefficient is what we will use for calculating water need in our area.

Water Need Based on Historic Reference ETo

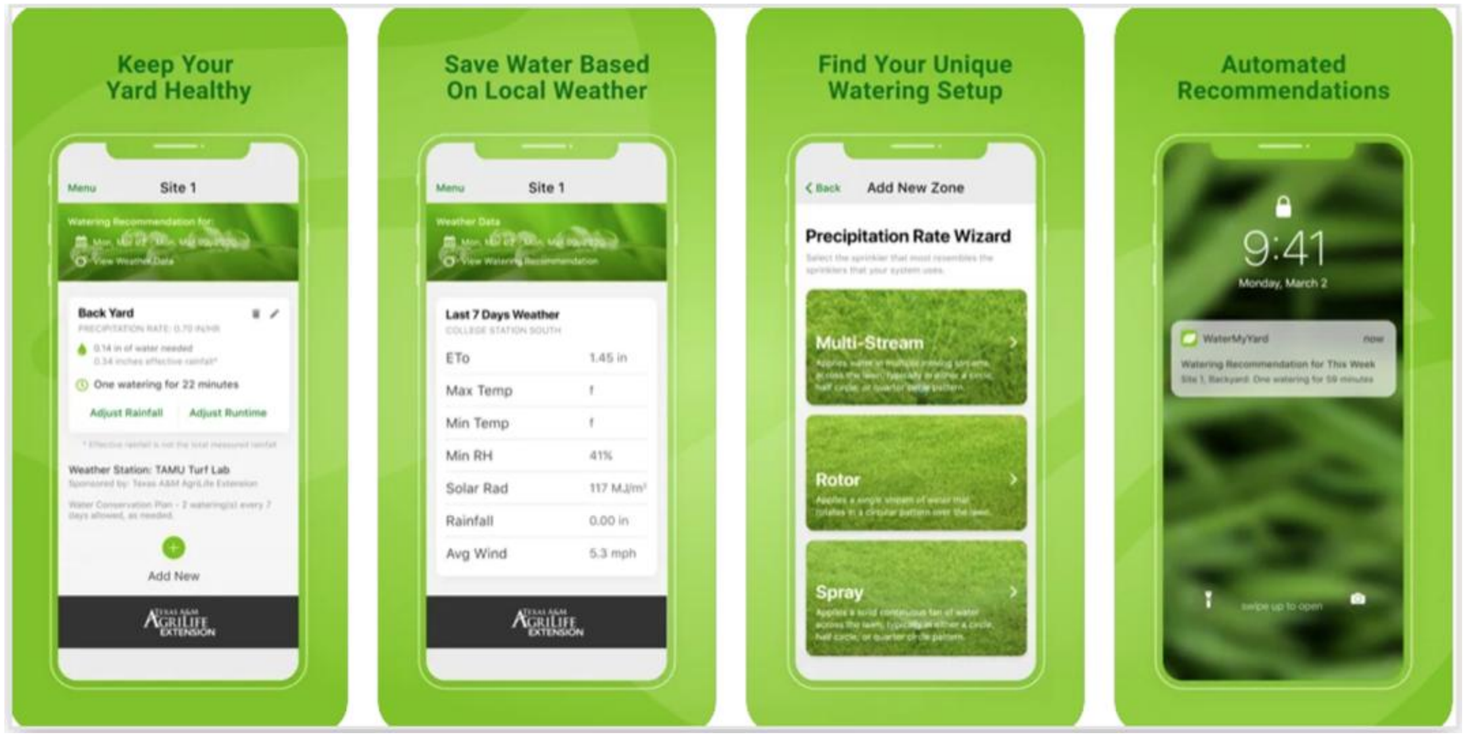
Reference ET x Crop Coefficient = Actual Turf ET

ETo	x	Kc	=	ETa
55.85”	x	0.6	=	33.51”
33.51”	x	0.6 (stress factor)	=	20.11”

Historic ETo Reference

City	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Abilene	2.08	2.57	4.14	5.48	6.47	7.65	8.36	7.46	5.48	4.21	2.67	2.08
Amarillo	1.84	2.27	3.73	5.06	5.89	7.51	8.08	7.29	5.61	4.05	2.40	1.78
Austin	2.27	2.72	4.34	5.27	6.39	7.15	7.22	7.25	5.57	4.38	2.74	2.21
Brownsville	2.65	3.03	4.48	5.17	6.03	6.32	6.68	6.65	5.21	4.34	3.01	2.59
College Station	2.20	2.71	4.22	5.20	6.25	6.89	7.10	6.85	5.60	4.30	2.80	2.20
Corpus Christi	2.42	2.95	4.28	5.17	5.95	6.43	6.68	6.65	5.21	4.34	3.01	2.59
Dallas / Ft Worth	2.00	2.46	3.96	5.14	6.21	7.06	7.40	7.25	5.49	4.19	2.59	2.10
Del Rio	2.47	3.01	4.76	6.01	6.98	7.41	7.57	7.41	5.77	4.35	2.91	2.36
El Paso	2.74	3.53	6.07	8.19	9.83	11.12	9.19	8.94	7.69	5.89	3.58	2.49
Galveston	2.20	2.60	4.10	5.00	6.11	6.60	6.20	6.00	5.50	4.20	2.80	2.30
Houston	2.36	2.83	4.32	5.01	6.11	6.57	6.52	6.08	5.57	4.28	2.90	2.35
Lubbock	2.35	2.63	4.41	5.53	6.93	7.73	7.63	7.20	5.54	4.19	2.61	2.33
Midland	2.20	2.78	4.46	5.91	7.21	8.20	9.23	8.62	6.96	4.31	2.78	2.16
Port Arthur	2.25	2.63	3.95	5.09	6.12	6.60	5.81	5.61	5.46	4.18	2.76	2.23
San Angelo	2.88	3.13	5.31	7.01	8.48	9.16	9.29	8.49	6.60	5.08	3.37	2.54
San Antonio	2.42	2.90	4.42	5.47	6.47	6.97	7.31	6.99	5.64	4.44	2.85	2.36
Victoria	2.35	2.87	4.29	5.77	6.39	6.70	6.92	6.70	5.36	4.41	2.93	2.33
Waco	2.13	2.62	4.03	5.31	6.45	7.15	7.40	7.50	5.70	4.41	2.70	2.17
Wichita Falls	1.94	2.46	4.07	5.50	6.70	7.54	7.97	7.72	5.79	4.30	2.62	1.95

Water My Yard *watermyyard.org*



Texas Water Resources Institute
make every drop count

Watering Recommendations from Texas ET Network

- Daily or weekly watering recommendation based on percentage of actual ET (ET_a)
- Adjustable and customizable for landscape type
- Create multiple profiles for different locations
- *texaset.tamu.edu*

Texas Water Resources Institute
make every drop count

Texas A&M AgriLife Extension

Texas ET Network

Login to your profile

Irrigation Water Requirements — Saturday July 4, 2026

Site Name: Home Change Info

Water Requirements: 1.3 inches

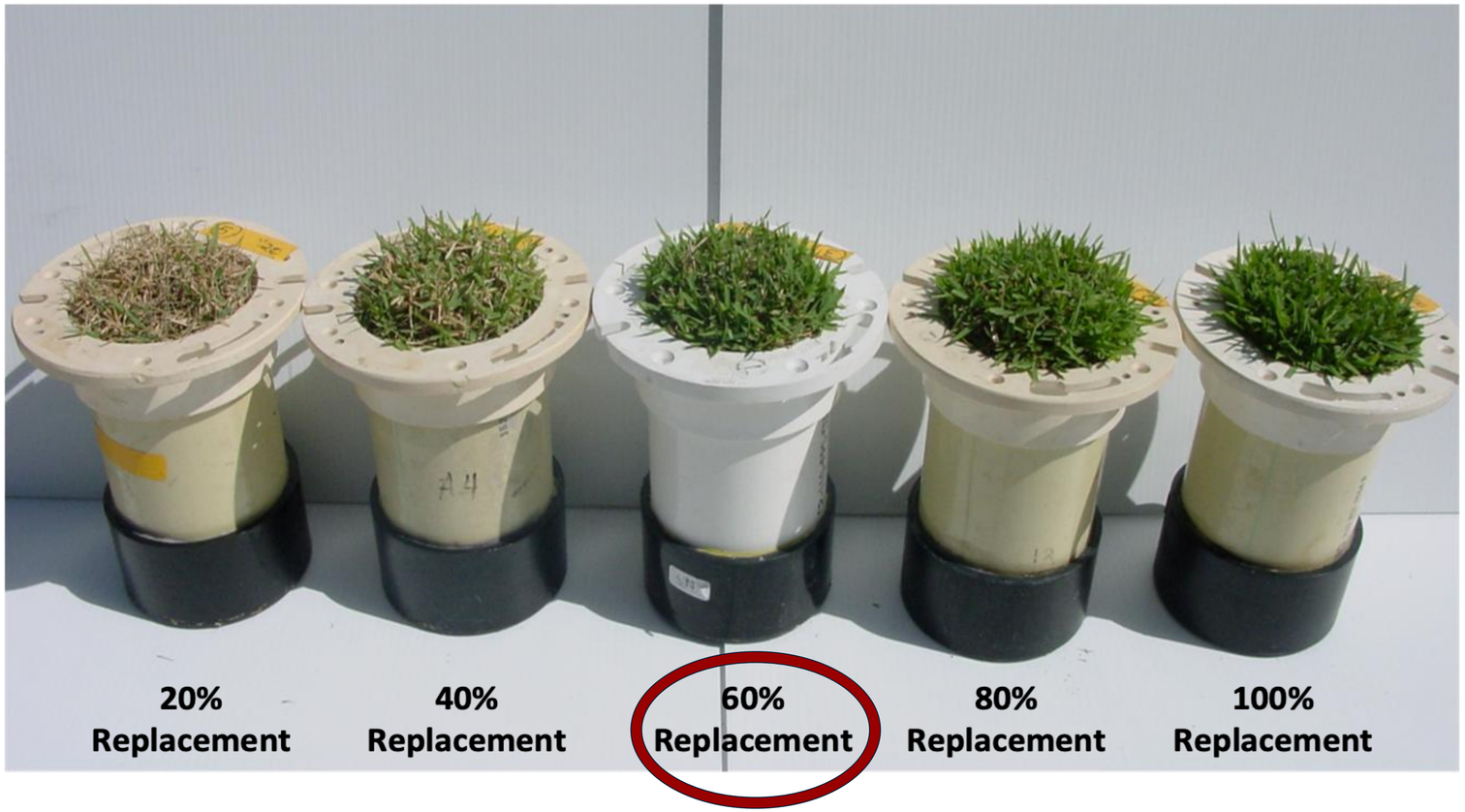
Plant Coefficient: 0.6
Plant Type:
Allowable Stress Factor: 0.6
Effective Rainfall: 0 inches

Lewisville's 7 Day Weather Summary *Sponsored by Upper Trinity Regional Water District*

Date	ETo (in)	Max Temp (f)	Min Temp (f)	Min RH (%)	Solar Rad. (MJ/m2)	Rainfall (in)	Wind 4am (mph)	Wind 4pm (mph)
Jul 03, 2026 - Fri	0.28	96	79	31	26.24	0.00	3.79	4.56
Jul 02, 2026 - Thu	0.28	94	80	33	26.48	0.00	3.97	5.68
Jul 01, 2026 - Wed	0.29	93	79	36	24.82	0.00	5.65	7.38
Jun 30, 2026 - Tue	0.30	93	78	36	26.62	0.00	7.56	7.80
Jun 29, 2026 - Mon	0.35	95	81	33	26.61	0.00	9.38	11.00
Jun 28, 2026 - Sun	0.34	94	79	40	27.00	0.00	8.07	10.39
Jun 27, 2026 - Sat	0.34	94	79	37	26.41	0.00	8.71	10.74
Data Summary	2.17	96	78	35	184.18	0.00	6.73	8.22

* Effective rainfall is not the total measured rainfall

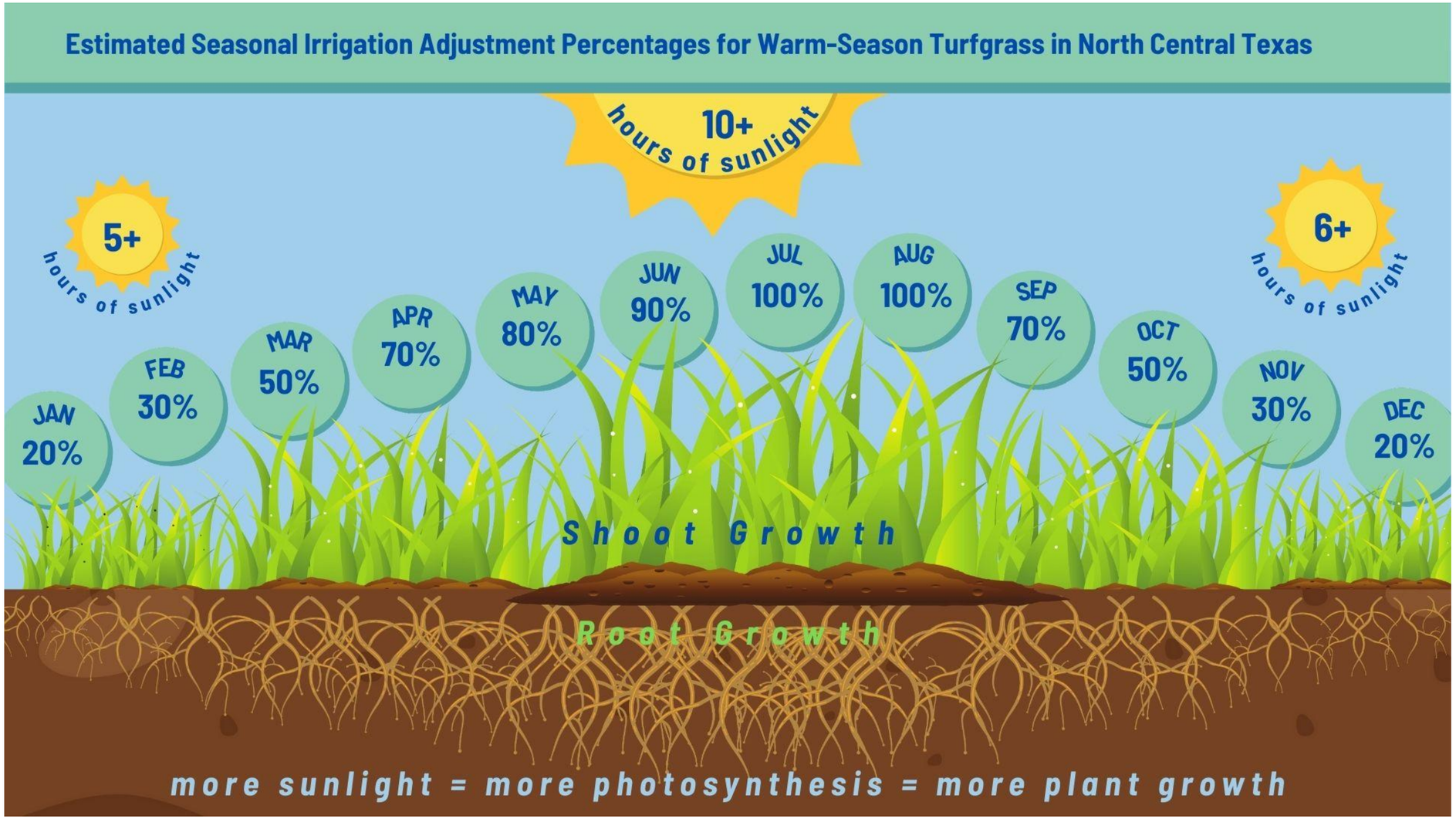
Percentage of ET Replacement



60% of water replacement can still produce a quality turfgrass

Texas Water Resources Institute
make every drop count

Seasonal Irrigation Adjustment



Texas Water Resources Institute
make every drop count

- ET and coefficient calculations provide the amount of water a plant needs...
- But we need to know how to apply that amount of water.
- We need to find the precipitation rate.

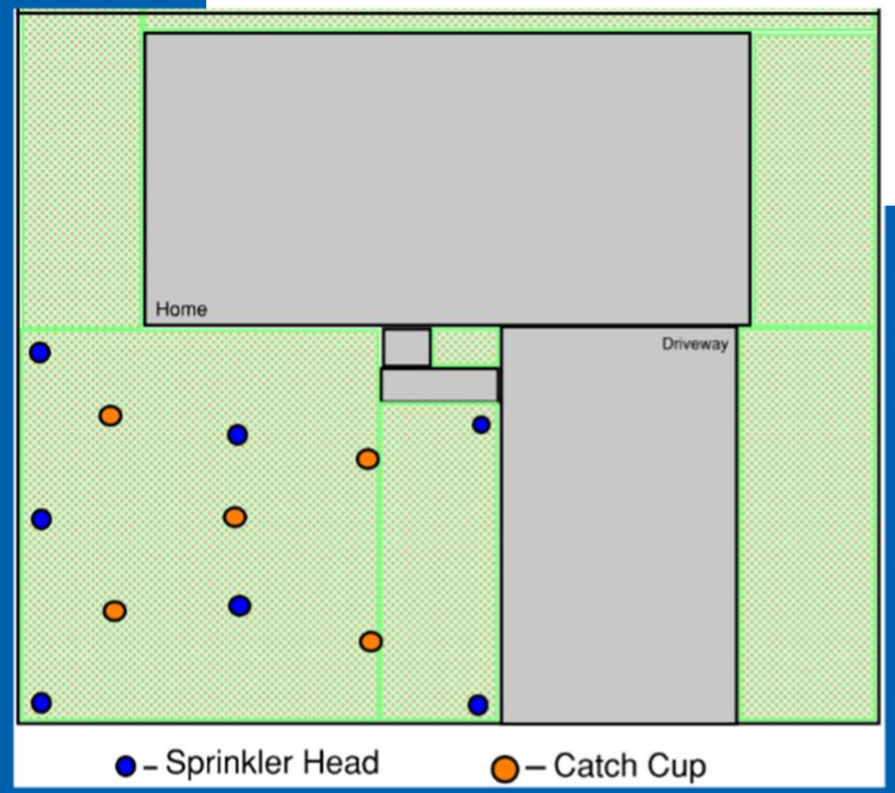
Texas Water Resources Institute
make every drop count

Texas Water Resources Institute

Home Catch Can Test

Things you will need:

- **Ruler or Tape Measure**
  - ***To measure water depth in cans***
- **Flat low-sided cans** (all the same)
  - ***Tuna or cat food cans work great***
- **Stop watch**
  - ***To track running time***
- **Calculator**
  - ***To add water values and calculate precipitation rate***



Watering Calculations

Precipitation Rate

$$PR = \frac{\text{Average Catch Can Rate}}{\text{Test Run-Time (Minutes)}}$$

$$PR = \frac{.41}{15} \times 60$$

PR = 1.64 in/hr

Repeat for each zone

Catch Can Amounts 15 Minutes	
Can	Amount (Inches)
1	.25
2	.31
3	.47
4	.30
5	.42
6	.28
7	.50
8	.45
9	.47
10	.58
11	.40
12	.52
Total/Average	**.41**

Texas Water Resources Institute
make every drop count

Irrigation System Water Usage Based on Gallons Per Minute

station	Station Information	GPM	Run Time Program A	Run Time Program B	Run Time Program C	Run Time Program D	Gallons Used A	Gallons Used B	Gallons Used C	Gallons Used D	
1	sprays/left of drive/turf/sun	12	8				96				
2	sprays/front yard/turf/sun-shade mix	15	8				120				
3	sprays/right side and Front yard/turf/sun	18	8				324				
4	rotors/backyard/turf/sun-shade mix	11	12				132				
5	rotors/backyard/turf/sun	14	15				210				
6	rotors/backyard/turf/sun	15	15				225				
7	sprays/backyard - along fence/turf/sun	10	8				80				
8	sprays/right side beds/sun-shade mix	10	6				60				
9	sprays/right side (sidewalk)/turf/sun	10	8				80				
10	sprays/backyard/right corner/turf and beds/sun	8	4				32				
11	sprays/side yard along fence/shrubs/sun	14	6				84				
12											
13											
14											
15											
	Irrigation Cycle Total						1443				
	Cycles per month						16				Total Gallons
	Total Monthly Gallons						23,088				23,088

	Program	Program A					Program B				
	Start Times	2:30 AM	4:45 AM								
	Water Days	Thursday/Sunday									

The precipitation rate for an entire area can be determined using this formula.

$$PR = \frac{96.3 \times \text{Total GPM}}{\text{Total Area}}$$

Texas Water Resources Institute
make every drop count

Watering Calculations

Sprinkler Run Time

$$RT = \frac{\text{Irrigation Amount}}{\text{Precipitation Rate}}$$

$$RT = \frac{1(\text{inch})}{1.64} \times 60$$

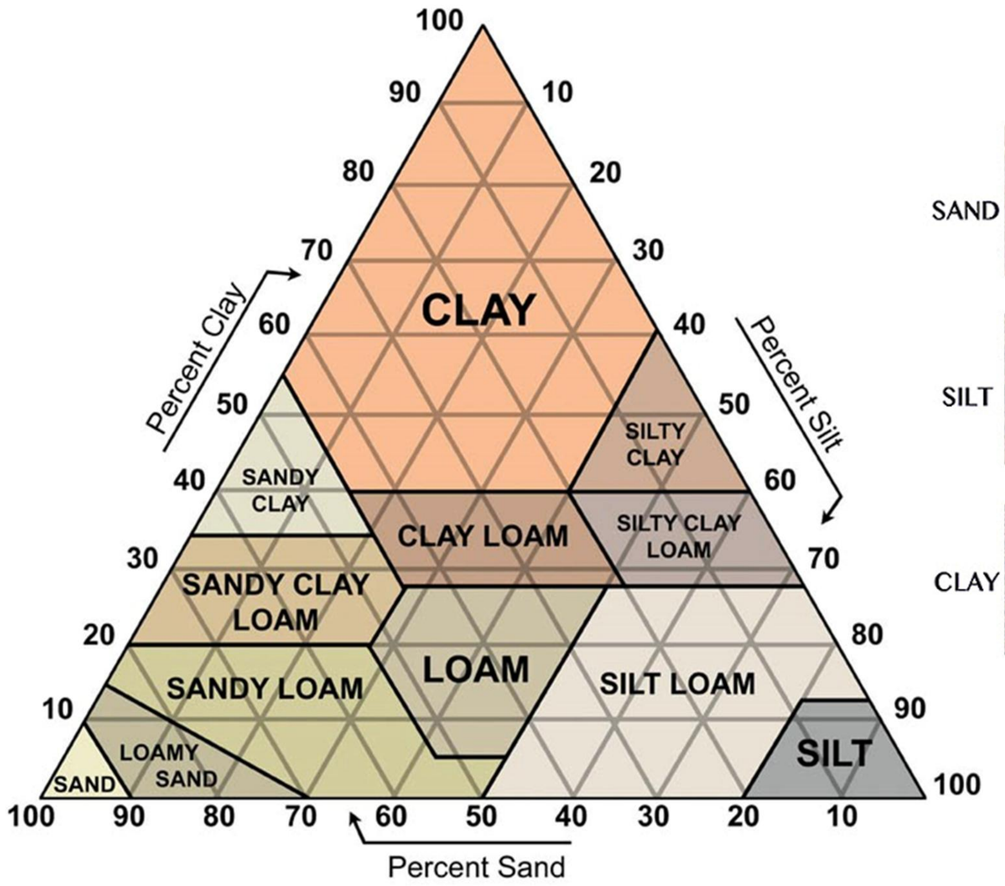
RT = 36.58 minutes

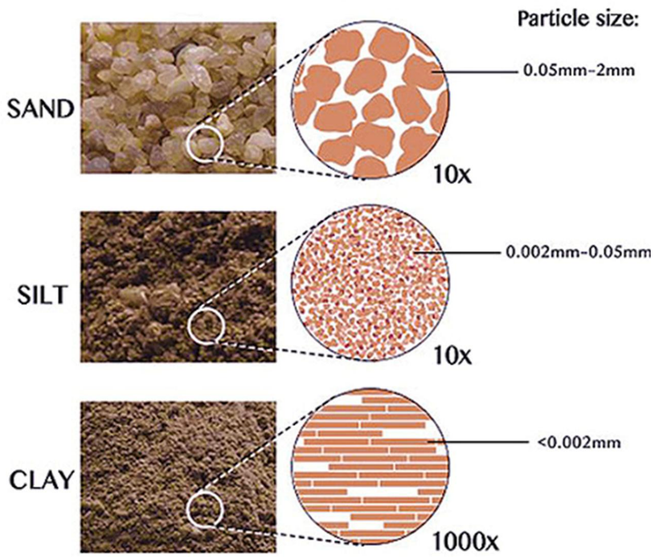
Texas Water Resources Institute
make every drop count

Cycle and Soak *cont…*

Infiltration Rates for Common Soil Types

The movement of water in the soil depends on the soil structure





Texas Water Resources Institute
make every drop count

Cycle and Soak *cont…*

Infiltration Rates for Common Soil Types

SOIL TYPE	STEADY INFILTRATION RATE (INCHES/HOUR)
SANDS	> 0.8
LOAMS	0.2 – 0.4
CLAYS	0.04 – 0.2

Cycle and Soak *cont*…

Average Sprinkler Application Rates

SPRINKLER TYPE	AVERAGE APPLICATION RATE (INCHES/HOUR)
FIXED SPRAYS	1.5 – 2.0
ROTORS	0.5
ROTARY NOZZLES	0.4 – 0.6

Infiltration rate v. Application Rate (side by side)

SOIL TYPE	STEADY INFILTRATION RATE (INCHES/HOUR)
SANDS	> 0.8
LOAMS	0.2 - 0.4
CLAYS	0.04 - 0.2

SPRINKLER TYPE	AVERAGE APPLICATION RATE (INCHES/HOUR)
FIXED SPRAYS	1.5 - 2.0
ROTORS	0.5
ROTARY NOZZLES	0.4 - 0.6

Common Lawn Sprinkler Types

Fixed Spray

Multi-Stream Rotators

Rotary Nozzles

Texas Water Resources Institute
make every drop count

Water Waste

Avoiding Irrigation Runoff

Irrigation runoff is a waste of water resources that can easily be avoided by using simple watering best practices

Texas Water Resources Institute
make every drop count

Texas Water Resources Institute

Mowing

- ❑Why its important
- ❑Timing
- ❑Height of cut

Mowing

Not just a chore

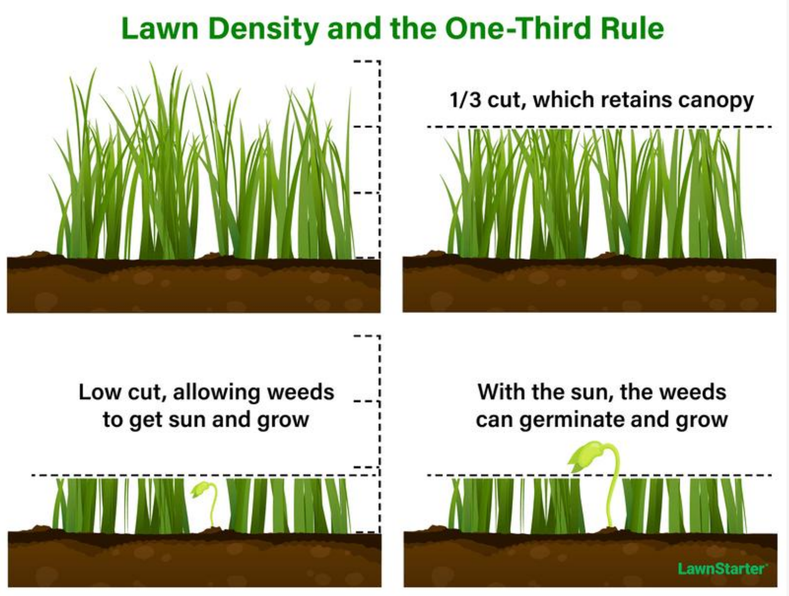
- When done properly, it can improve health and appearance
- Mowing practices impact turfgrass response to stresses
  - Frequency and height of cut
  - Drought and temp extremes
  - Shade
  - Nutrients
  - Traffic
- Adopting appropriate mowing practices that support healthy turf

Texas Water Resources Institute
make every drop count

Mowing

Timing

- Follow the 1/3 rule: No more than 1/3 of the plant material should removed at any one time
- Mowing frequency is determined by rate of growth
  - Light exposure
  - Temperatures
  - Precipitation
  - Nutrient management
- Twice-weekly mowing may be necessary during the warmer months
- Scalping is not recommended…ever!



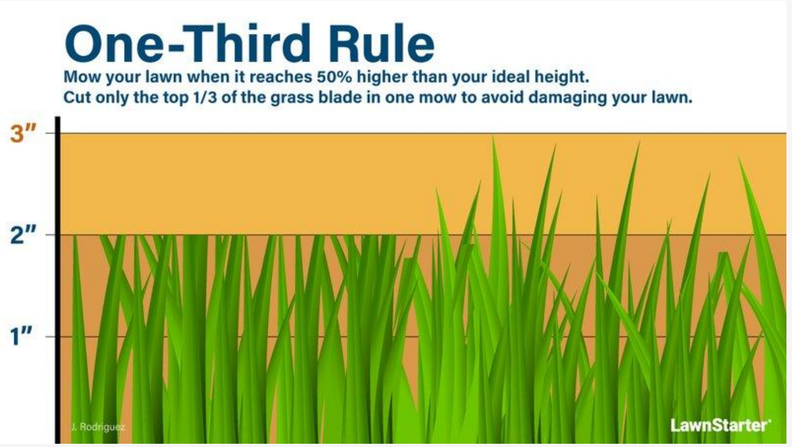


Photo Credit: Juan Rodriguez

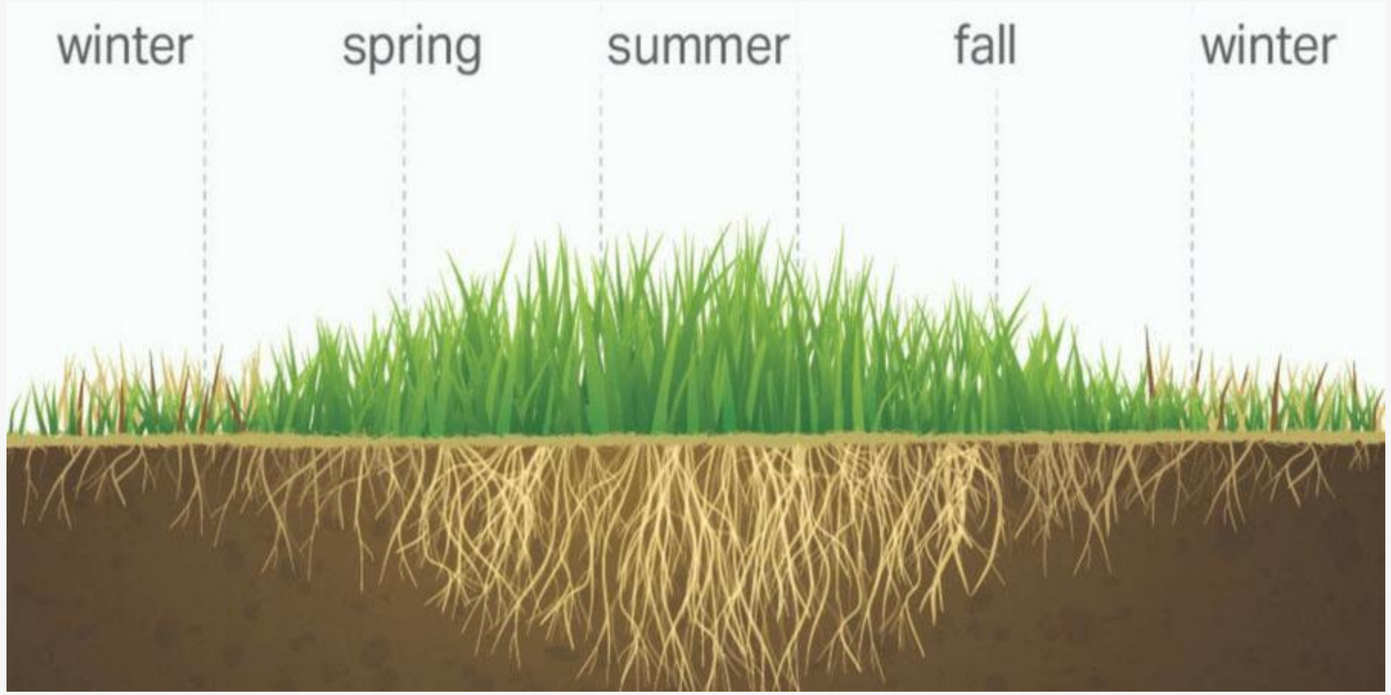
https://www.lawnstarter.com/blog/lawn-care-2/mowing-height-last-mow-low/

Texas Water Resources Institute
make every drop count

Mowing

Timing

- Spring
  - First mowing of the season can be shorter…but not scalped.
- Summer
  - Mow taller (not over recommended height) to support the seasons environmental stressors.
- Fall
  - Keep mowing turf at maximum height to prepare for winter dormancy.



Texas Water Resources Institute
make every drop count

Mowing

Height of Cut

- Shade
  - St. Augustine and Zoysia are the best options for shade
  - Keep height of cut toward the maximum to encourage photosynthesis
- Winter Maintenance
  - Warm season turfgrass enters dormancy when soil temps drop below 50-55*F
  - Only mow off and bag winter weeds

Table 1. Mowing height recommendations for warm-season turfgrass species in a lawn scenario

Warm-season turfgrass species		Recommended height of cut	
Common name	Scientific name	Rotary mower	Minimum height with reel mower*
Bermudagrass (Common)	*Cynodon dactylon*	1.5" to 4"	0.75"
Bermudagrass (Hybrid)	*Cynodon dactylon* (L.) Pers and *Cynodon dactylon* (L.) Pers x *Cynodon transvaalensis* Burtt Davy	1.5" to 2.5"	0.75"
Buffalograss	*Bouteloua dactyloides* (Nutt.) J.T. Columbus	2" to unmowed	2"
Centipedegrass	*Eremochloa ophiuroides* (Munro) Hack.	1.5" to 2"	1"
Seashore Paspalum	*Paspalum vaginatum* Sw.	1.5" to 2"	0.75"
St. Augustinegrass	*Stenotaphrum secundatum* (Walt.) Kuntze	2.5" to 5"	2.5"
Zoysiagrass (Coarse-textured)	*Zoysia japonica*	1.5" to 4"	1"
Zoysiagrass (Fine-textured)	*Zoysia matrella*	1.5" to 2"	0.75"

*Reel mowers will allow for a lower height of cut (HOC) than a rotary mower. In some cases, it may be desirable to maintain a shorter mowing height (<1.5 inches) when a reel mower is available, depending on desired aesthetics and functionality of a particular site. However, it should be noted that when using a reel mower to maintain a lower height of cut, more frequent mowing—sometimes three times per week—is often required.

Grass-(Re)Cycling

Grass clippings are a significant source of nitrogen

- Can reduce annual nitrogen needs by up to 50%
- Rapidly decomposed by soil microbes
- Increases soil water holding capacity
- Does not contribute to thatch or disease

https://doi.org/10.2135/cropsci2002.1225

Texas Water Resources Institute
make every drop count

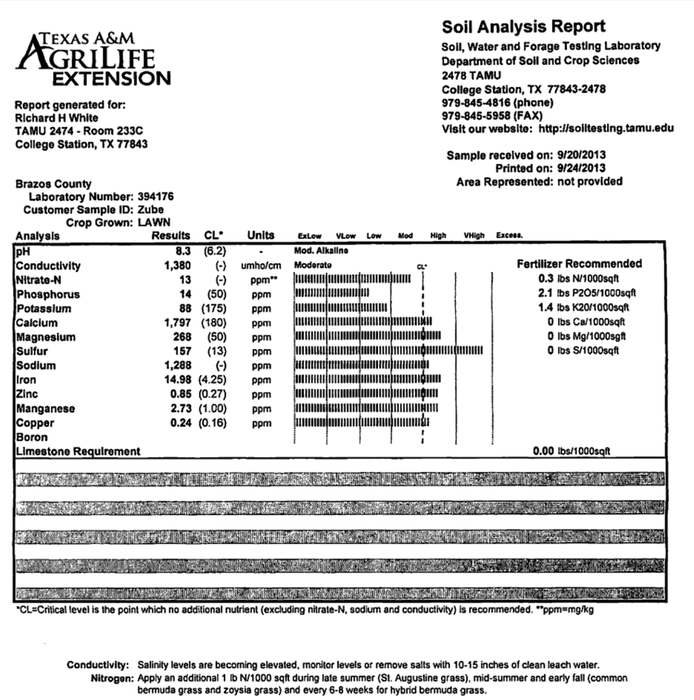
Texas Water Resources Institute

Fertilizing

- ❑What
- ❑When
- ❑How

Essential Nutrients

Don't Guess, Test.



TEXAS A&M AGRILIFE EXTENSION

Soil Analysis Report

Soil, Water and Forage Testing Laboratory
Department of Soil and Crop Sciences
2478 TAMU
College Station, TX 77843-2478
979-845-4816 (phone)
979-845-5958 (FAX)
Visit our website: http://soiltesting.tamu.edu

Report generated for:
Richard H White
TAMU 2474 - Room 233C
College Station, TX 77843

Sample received on: 9/20/2013
Printed on: 9/24/2013
Area Represented: not provided

Brazos County
Laboratory Number: 394176
Customer Sample ID: Zube
Crop Grown: LAWN

Analysis	Results	CL*	Units	ExLow VLow Low Mod High VHigh Excess.	Fertilizer Recommended
pH	8.3	(6.2)	-	Mod. Alkaline	
Conductivity	1,380	(-)	umho/cm	Moderate CL*	
Nitrate-N	13	(-)	ppm**		0.3 lbs N/1000sqft
Phosphorus	14	(50)	ppm		2.1 lbs P2O5/1000sqft
Potassium	88	(175)	ppm		1.4 lbs K2O/1000sqft
Calcium	1,797	(180)	ppm		0 lbs Ca/1000sqft
Magnesium	268	(50)	ppm		0 lbs Mg/1000sqft
Sulfur	157	(13)	ppm		0 lbs S/1000sqft
Sodium	1,288	(-)	ppm		
Iron	14.98	(4.25)	ppm		
Zinc	0.85	(0.27)	ppm		
Manganese	2.73	(1.00)	ppm		
Copper	0.24	(0.16)	ppm		
Boron					
Limestone Requirement					0.00 lbs/1000sqft

*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended. **ppm=mg/kg

Conductivity: Salinity levels are becoming elevated, monitor levels or remove salts with 10-15 inches of clean leach water.
Nitrogen: Apply an additional 1 lb N/1000 sqft during late summer (St. Augustine grass), mid-summer and early fall (common bermuda grass and zoysia grass) and every 6-8 weeks for hybrid bermuda grass.

www.soiltesting.tamu.edu

Macronutrients					
Derived from Air and Water		**Primary**		**Secondary**	
Carbon	C	Nitrogen	N	Sulfur	S
Oxygen	O	Phosphorous	P	Calcium	Ca
Hydrogen	H	Potassium	K	Magnesium	Mg
Micronutrients					
Iron	Fe	Copper	Cu	Zinc	Zn
Molybdenum	Mo	Manganese	Mn	Chlorine	Cl
Boron	B	Nickel	Ni		
Other Beneficial and Sometimes Essential Nutrients					
Cobalt*	**Co**	Silicon	Si	Aluminum	Al
Sodium	Na	Selenium	Se	Vanadium	V

Texas Water Resources Institute
make every drop count

Nitrogen Fertilization

Why Apply and How Much

Determining whether to apply nitrogen (N) and/or how much N to apply depends on:

- Turfgrass species
- Desired outcome: green and pristine vs. utility
- Maintenance: Fertilization can require more maintenance
- Use: High traffic vs. ornamental

TURFGRASS SPECIES	YEARLY NITROGEN REQUIREMENT (LBS N/1000 SQ FT/YEAR)
BERMUDAGRASS (common)	2 - 4
BERMUDAGRASS (hybrid)	3 - 6
ST. AUGUSTINEGRASS	1 - 3
ZOYSIAGRASS (*japonica*) *(Palisades, El Toro, JaMur)*	2 - 3
ZOYSIAGRASS (*matrella*) *(Emerald, Zeon)*	1 - 2

Nitrogen Fertilization

How Much?

Follow this formula to calculate how much fertilizer to apply:

- Recommended application rate of **nitrogen** = .5 lbs per 1000 sq ft.
- N - P – K
- Represents the % by weight of NPK
- Divide each number by 100 to get the fraction for calcualting application rate.

FERTILIZING

More isn't always better

SOILTESTING.TAMU.EDU

Scenario: Apply ½ pound of nitrogen fertilizer per 1000 square-feet of lawn for a 3500 square-foot lawn.
Product: 6(N = Nitrogen) – 1(P = Phosphorous) – 2(K = Potassium) slow-release fertilizer in a 40lb bag.

APPLICATION RATE / ANALYSIS = AMOUNT PER 1000 SQ FT

.5 LBS. (N) / .06 = 8.33 LBS. (N) PER 1000 SQ FT
(recommendation) (analysis) (amount of nitrogen for every 1000 square-feet)

8.33 X 3.5 (3,500 SQ FT Lawn) = 29.05 LBS. FERTILIZER

Texas Water Resources Institute
make every drop count

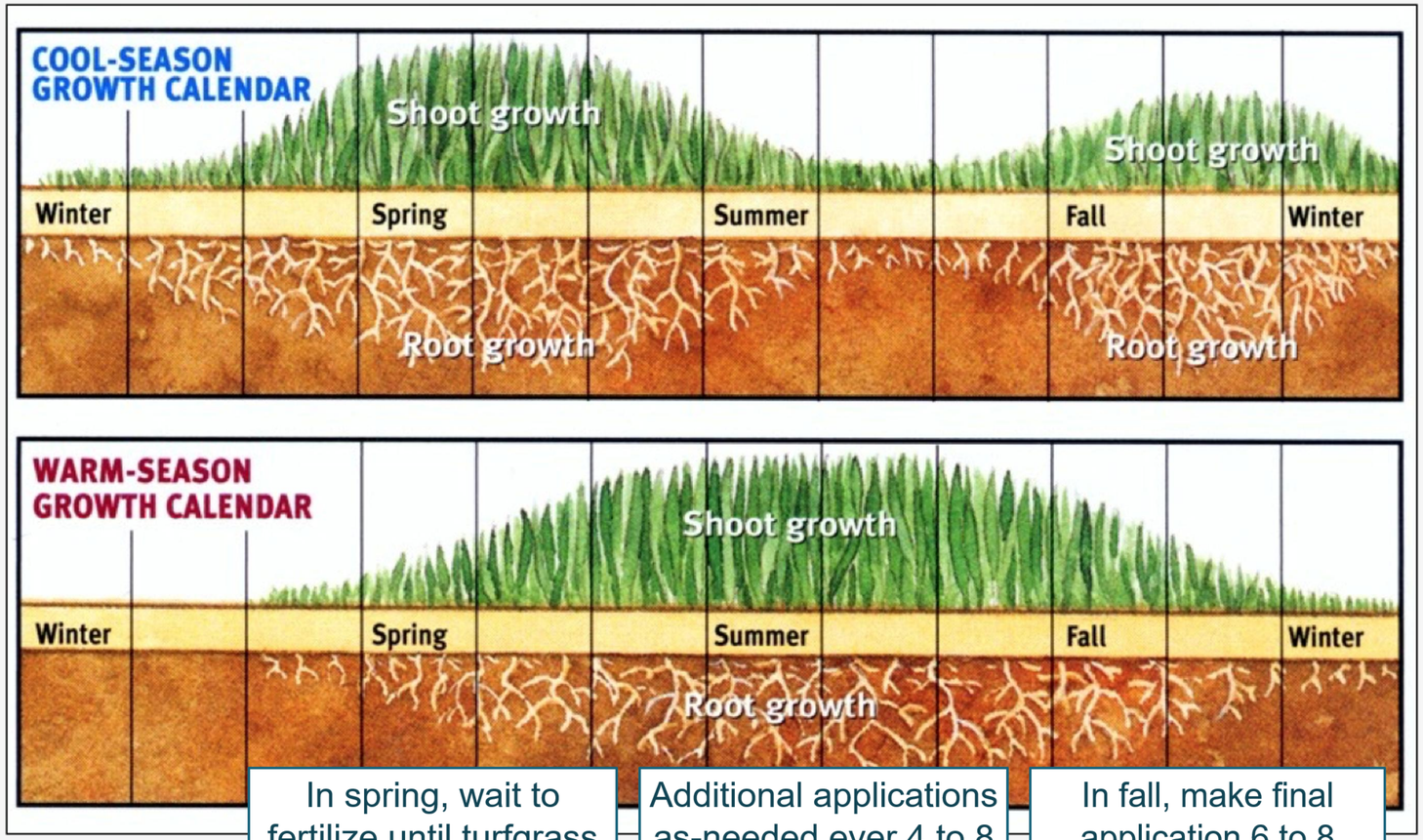
Nitrogen Fertilization

When?

Fertilize when the grass is actively growing

Last Frost Date (Spring)
- Average: March 12 – March 20
- Range: Early March to late March

First Frost Date (Fall)
- Average: November 13 – November 21
- Range: Early to late November



In spring, wait to fertilize until turfgrass has been mowed twice.

Additional applications as-needed ever 4 to 8 weeks during growing season.

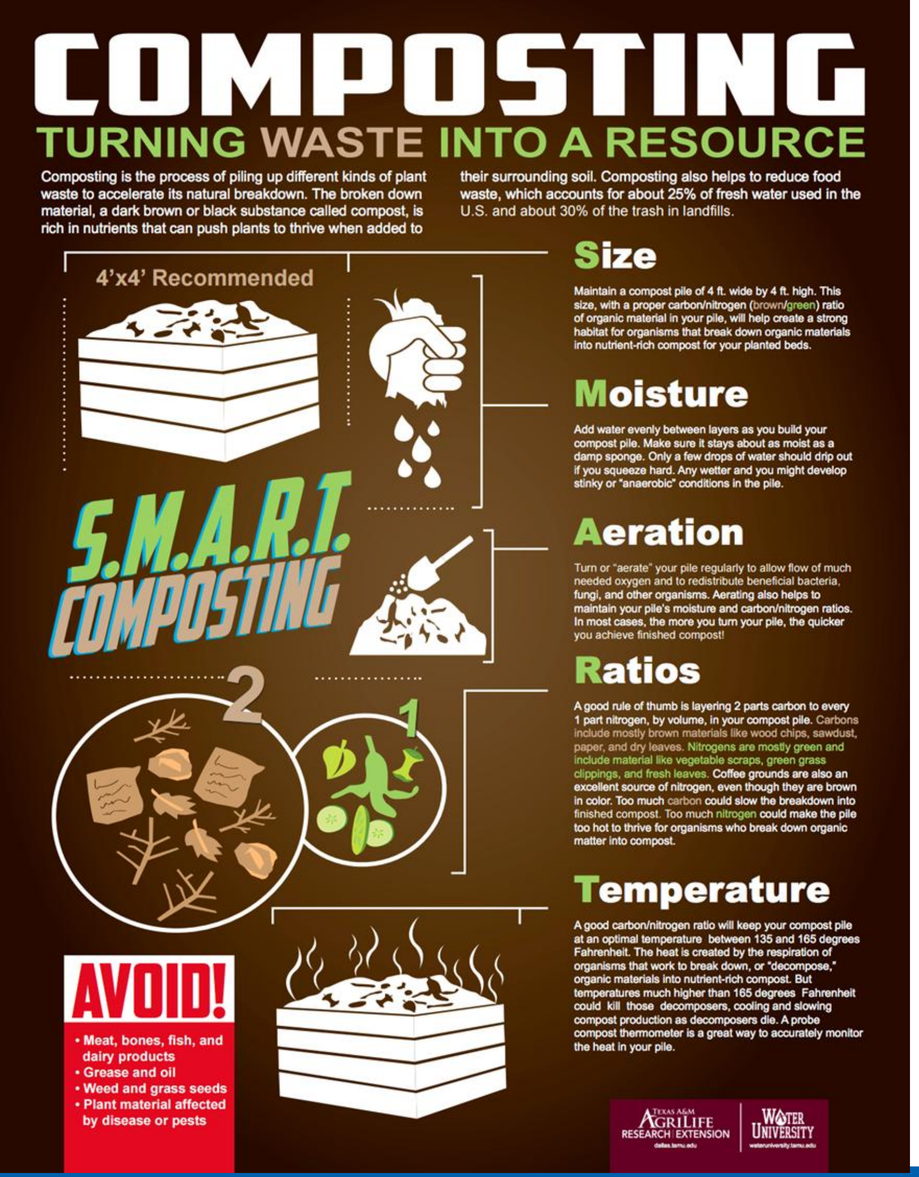
In fall, make final application 6 to 8 weeks before historic first frost.

Texas Water Resources Institute
make every drop count

Texas Water Resources Institute

Compost and Grass Clippings

YES!!



YOU'VE GOT A FRIEND IN COMPOST!

- Improved soil structure
- Improved infiltration
- Improved water holding capacity
- Improved nutrient retention and availability
- pH stabilization

Texas Water Resources Institute
make every drop count

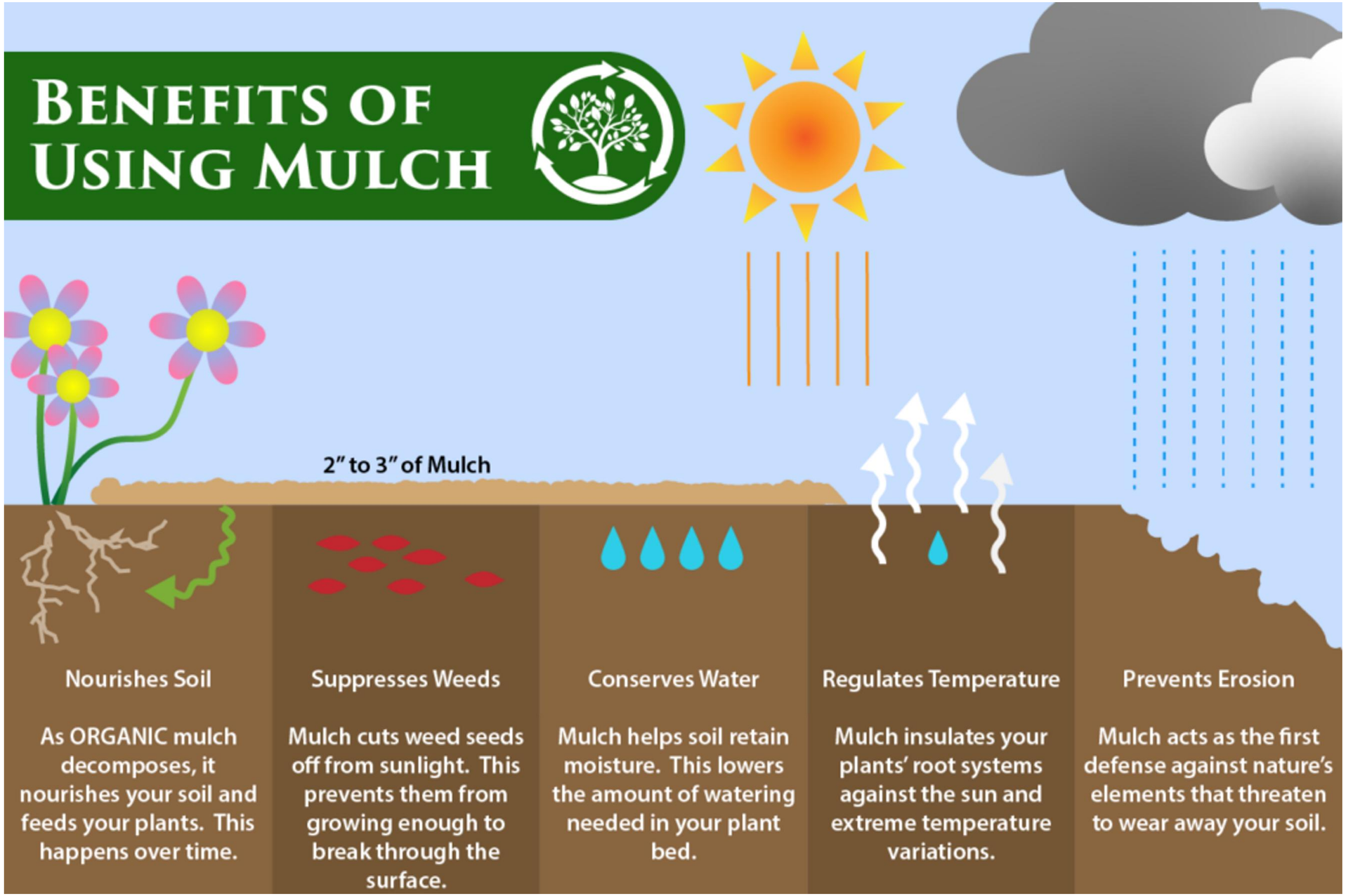
TOPDRESSING WITH COMPOST

Simple process of adding a topdressing material, usually compost to the lawn

- Adds microbes to increase decomposition
- Apply while turfgrass is actively growing
- ¼ to ½ - inch max
- Drag into turfgrass with a drag mat or rake

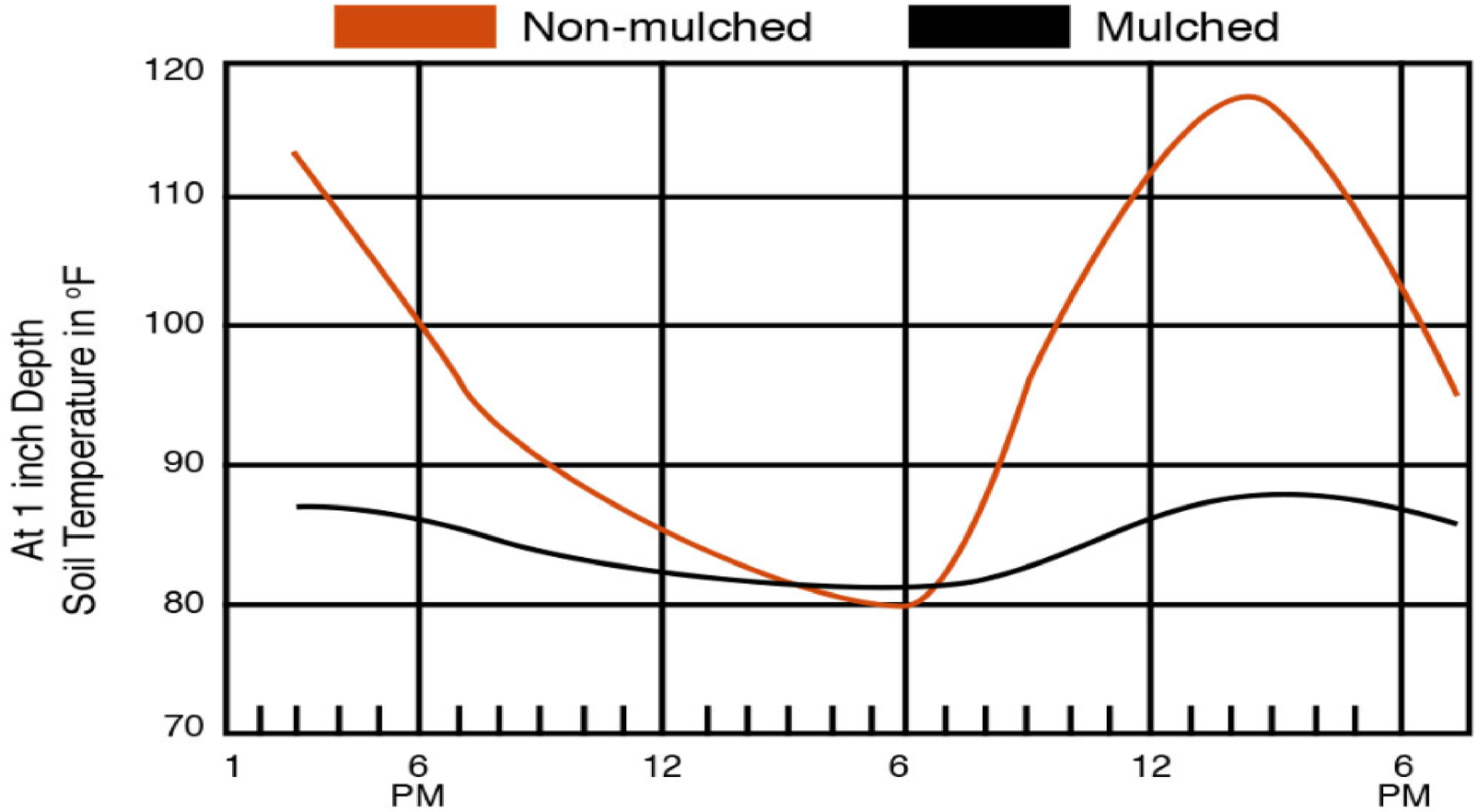
Benefits of Mulch

Texas Water Resources Institute
make every drop count



Texas Water Resources Institute
make every drop count

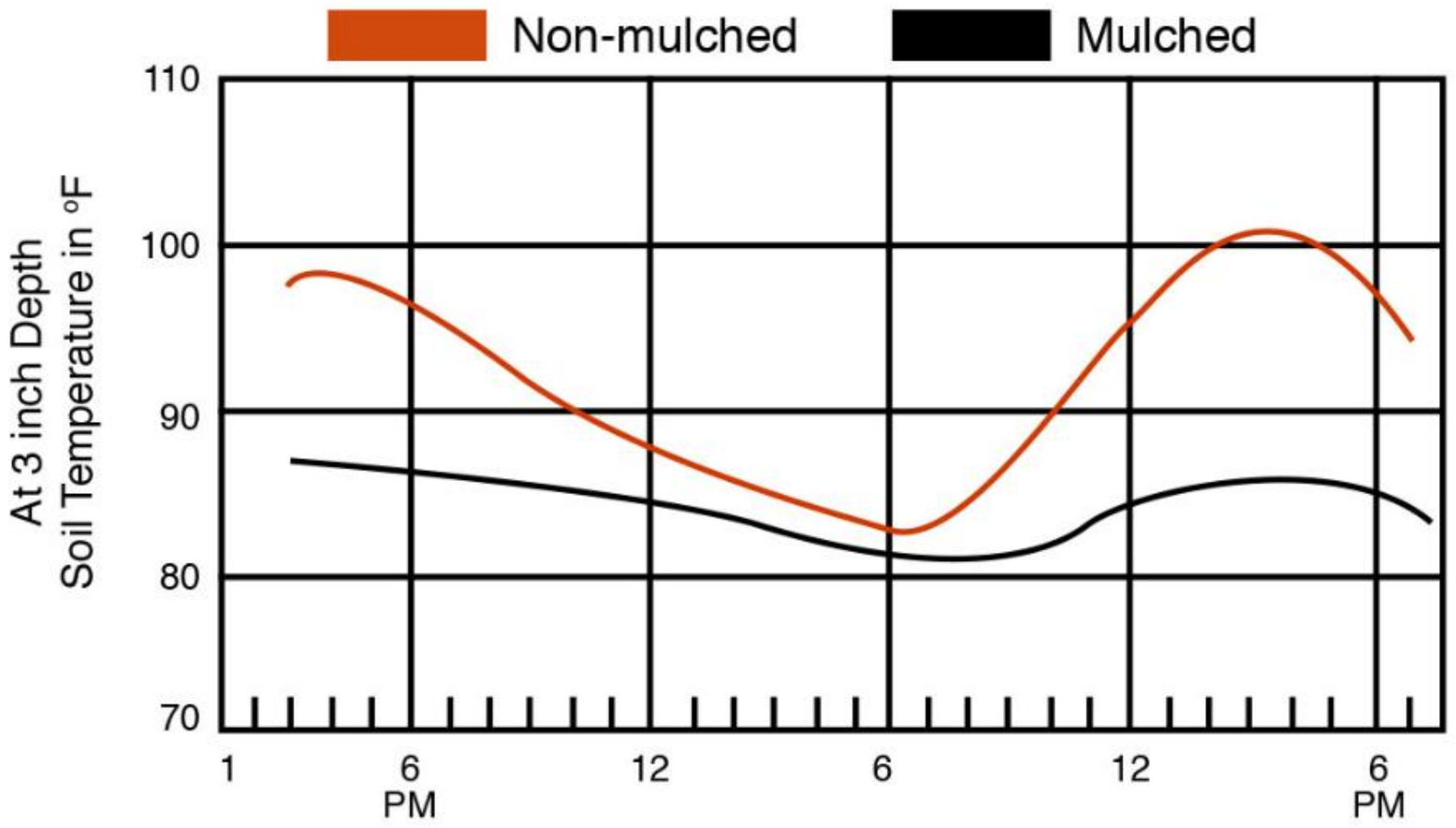
Soil Temperature Impacts of Mulch



https://extension.okstate.edu/fact-sheets/mulching-garden-soils

Texas Water Resources Institute
make every drop count

Soil Temperature Impacts of Mulch



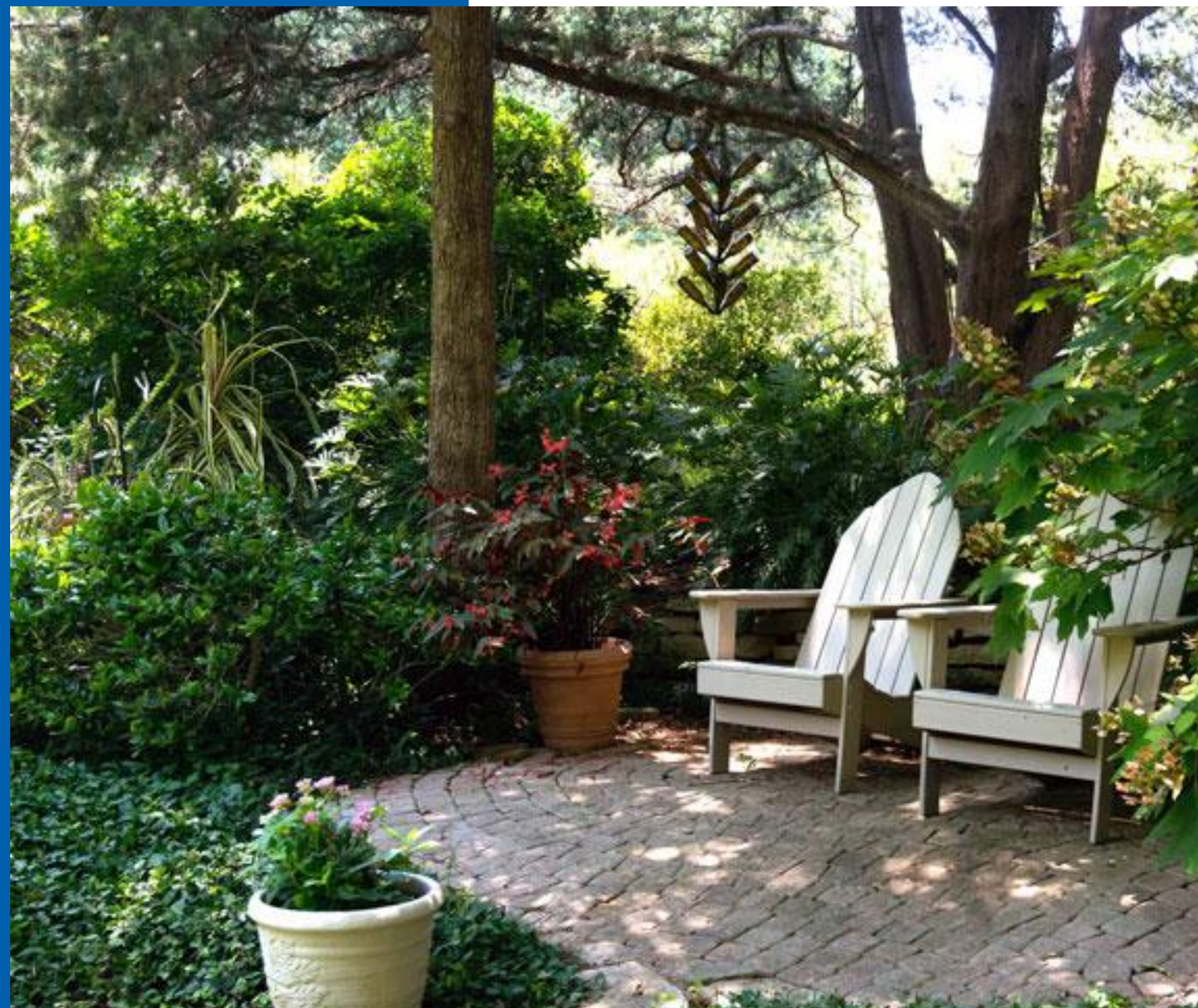
https://extension.okstate.edu/fact-sheets/mulching-garden-soils

Texas Water Resources Institute
make every drop count

Texas Water Resources Institute

Alternative Options

What to do in shade or areas not practical for turfgrass



Hardscape Options

Avoid concrete and heavy masonry

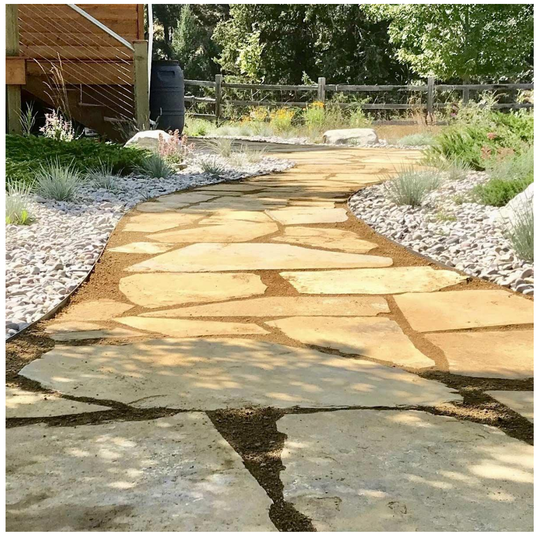
- Patio stones with Polymetric Sand
- Permeable pavers
- Decomposed granite
- Rock beds

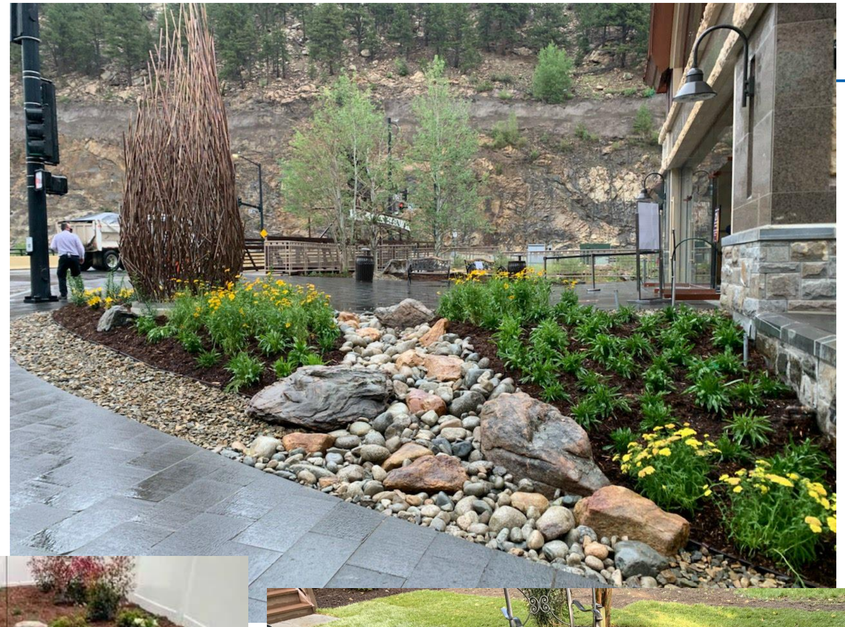
Texas Water Resources Institute
make every drop count

Hardscape Options

Avoid concrete and heavy masonry

- Permeable pavers
- Decomposed granite
- Rock beds





Texas Water Resources Institute
make every drop count

Proven Shade Plants for Texas

Base plant selection on landscape use case.

- Evergreens offer year-round texture and color
- Groundcovers may offer lower maintenance
- Ornamental trees offer height and additional shade

Ferns

Wavy Cloak Fern
Holly Fern
Autumn Fern
Southern Wood Fern

Groundcovers

Ajuga
Horse Herb
Purple Wintercreeper
Lamium
Frog Fruit

Ornamental Grasses

Inland Sea Oats
Indiangrass

Ornamental Trees

Japanese Maple
Redbud
Possumhaw Holly
Yaupon Holly
Cherry Laurel
Texas Mountain Laurel

Perennials

Berkeley Sedge
Native Sedges
Texas Gold Columbine
Cast Iron Plant
Gregg's Mistflower
Lenten Rose, Hellebore
Coral Bells, Heuchera
Turk's Cap
Garden Phlox
Lyre Leaf Sage
Cedar Sage
Leopard Plant

Shrubs

Beautyberry
Flowering Quince
Japanese Aralia
Oakleaf Hydrangea
St. John's Wort
Dwarf Yaupon Holly
Chinese Fringe Flower
Bridal Wreath Spirea
Bush Germander
Eastern Snowball Viburnum
Rusty Blackhaw Viburnum
Glossy Abelia
Japanese Yew
Oregon Grape Mahonia
Soft Caress Mahonia

Palms

Dwarf Palmetto

Proven Shade Plants for Texas

Frogfruit
(*Lippia nodiflora* (L.) Michx)

Description: Creeping, glabrous perennial with oblanceolate leaves widest near the apex and toothed margins only near the apex. Flower petals are very small, white to lavender in color but can also be blue to purple.

Texas Water Resources Institute
make every drop count

Proven Shade Plants for Texas

Ajuga or Bugleweed

(Ajuga repens)

Description: A small, evergreen plant that spreads eagerly and suppresses weeds, even in the deep shade where grass won't grow.

- Spikes of blue or pink flowers in spring
- Spreads quickly to suppress weeds
- Ideal for edging, slopes, or under trees
- Thrives in sun to full shade

Texas Water Resources Institute
make every drop count

Proven Shade Plants for Texas

Turkscap

Malvaviscus arboreus var. *drummondii*

Description: Full sun to partial shade; shrub-like perennial that is tough and drought tolerant.

- Blooms continuously in warm weather.
- Plant as an understory plant in any shady spot
- Attracts hummingbirds
- Grows as wide as tall – can reach 10 feet

Texas Water Resources Institute
make every drop count

Proven Shade Plants for Texas

Dwarf Texas Palmetto

Sabal minor

Description: Fan-shaped evergreen palm is a small shrub, 5-10 ft. tall. Usually stemless, with the leaves arising from an underground stock. Leaf blades longer than the leaf stalks. Grows as much as 4 feet wide

- White blooms are followed by black fruit.
- Plant will form a trunk when grown in standing water
- Tropical looking, yet drought tolerant

Texas Water Resources Institute
make every drop count

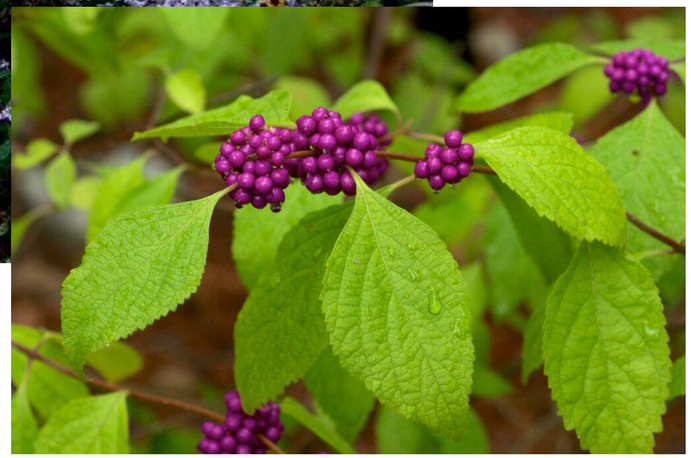
Proven Shade Plants for Texas (native)

American Beautyberry

(Callicarpa americana)

Description: Shade loving perennial shrub that prefers moisture and deep soil. Does not need trimming but can be managed. Grows 4-6’ tall and wide.

- Produces purple berry clusters in fall/winter.
- Use as an understory plant in any shady spot
- Great food source for wildlife



Texas Water Resources Institute
make every drop count

Sun/Shade Plants for Texas

Texas Mountain Laurel

(Dermatophyllum secundiflorum)

- Very drought and heat tolerant
- 10-15 feet tall
- Purple bloom clusters in spring
- Blooms attract pollinators
- Sun/Part Shade

Sun/Shade Plants for Texas

Foxtail Fern
(Asparagus desiflorus)

- Mounding evergreen perennial
- 18-24 inches tall and wide
- Cold hardy to 20F
- Drought tolerant
- Part sun – part shade

https://www.gardenstylesanantonio.com/wp-content/uploads/2021/09/urban-oasis.pdf

Sun/Shade Plants for Texas

Sedges
(*Carex* spp.)

- Clumping semi-evergreen grass-like plant
- 1-2 feet tall and wide
- Cold hardy to 20F
- Drought tolerant
- Sun – Shade
- Berkeley (*C. tumicola*)
- Meadow (*C. perdentata*)
- Texas (*C. texensis*)

https://www.gardenstylesanantonio.com/wp-content/uploads/2021/09/urban-oasis.pdf

Summer Color for Texas

Pink Skullcap
(Scuttelaria suffrutescens)

- Low growing tidy mounding plant
- 1-2 feet tall and 3’ wide
- Drought tolerant
- Sun – Part Shade
- Pink blooms all summer
- Can be cut back anytime to keep compact shape

Texas Water Resources Institute
make every drop count

Summer Color for Texas (native)

Blackfoot Daisy
(Melampodium leucanthum)

- Short daisy like flowers with yellow centers plant
- 6”-12” feet tall and 1-1.5’ wide
- Drought tolerant
- Sun
- Great rock garden plant
- Attracts pollinators

Texas Water Resources Institute
make every drop count

Summer Color for Texas

(native hybrid)

Lantana(hybrid)

(Lantana x hybrida)

Texas Lantana (*Lantana urticoides)*

- Prolific summer bloomer with many colors to choose. (New Gold)
- 2’-4’ feet tall and 4’ wide
- Drought tolerant
- Sun
- Attracts pollinators
- Durable plant but susceptible to spring freeze damage so don’t cut back too early

Texas Water Resources Institute
make every drop count

Texas Water Resources Institute

Thank You

Dean Minchillo
Urban Water Program Specialist
Texas A&M AgriLife Extension
Texas Water Resources Institute

TWRI.TAMU.EDU