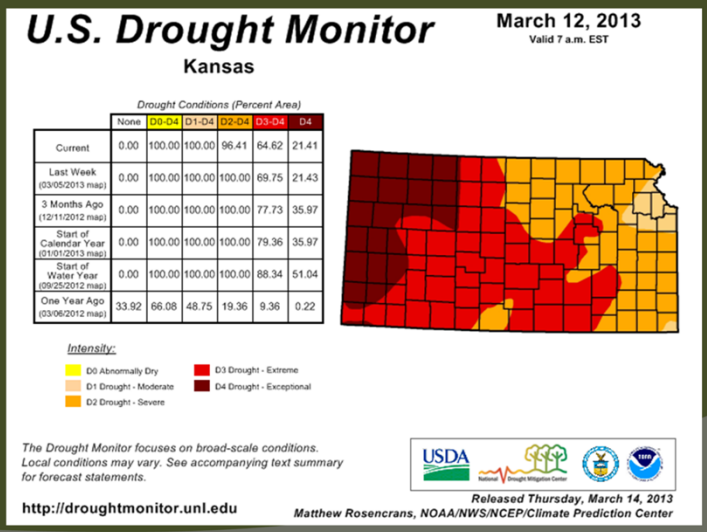
Grow Good Food Workshop
23 March 2013

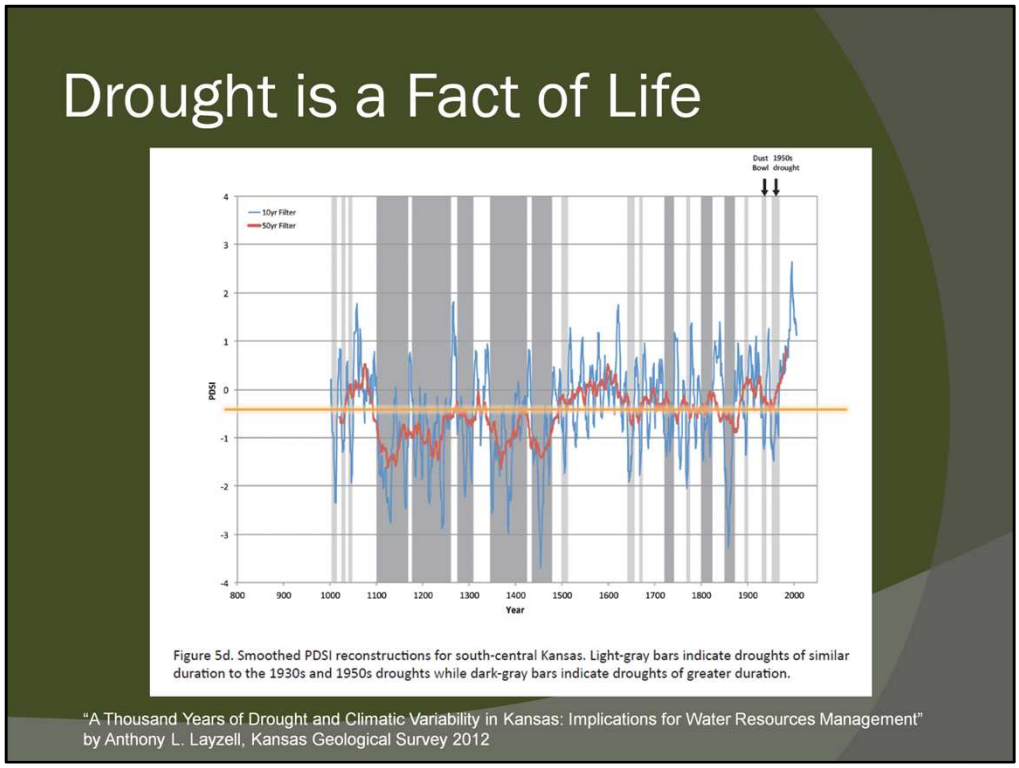
WATER WISE: GROWING A GARDEN IN HEAT & DROUGHT

I've heard it said more than once that gardening in Kansas is an exercise in futility. While I don't agree with that statement, I do know that you have to put out some effort and time to be able to get a decent harvest. And when drought rolls around, it separates the amateurs from skilled gardeners.

Drought is a Fact of Life



Palmer Drought Severity Index is a way of measuring drought. It takes into account weather, soil moisture, agriculture and grassland plant conditions, and the state of rivers, lakes and streams (hydrology) so as to make a judgment about intensity of drought conditions.



NOTES on 1000 YEARS OF DROUGHT IN KANSAS
From talk by Anthony 'Tony' Layzell, NSF IGERT Fellow, Kansas Geological Survey, to WATER Center Senior Wednesday, 6 March 2013
How unusual were the 1930 and 1950 droughts?
Drought is a period of abnormally dry weather that persists long enough that it creates economic, environmental and societal problems.
The climate gets stuck in patterns, either wet or dry.
Palmer Drought Severity Index 'PDSI' uses temperature, precipitation and soil moisture to arrive at a level of drought severity.
Kansas gets moisture in two ways: 1) Frontal, 2) Up from the Gulf of Mexico
California has 7000 years of tree ring weather data due to the Bristlecone pines.
Cook & Krusic, 2004, paper about methodology of determining historical weather from tree rings.
Tony filtered the data to knock off the peaks and valleys. The filtered data then shows the duration of the drought. The non-filtered data shows the severity.
Tony's work determined that a dust bowl drought of that length and severity can occur 1.4 times per century in South Central Kansas.
There are 3 scenarios for what can happen with the current drought moving forward:
Business as usual. This could be the type of drought such as occurred here during the 1930s and 1950s. There is a 1 to 2 times chance of this level of drought happening each century.
The medieval warm period was more the normal for the U.S. plains, therefore dryer will again become the area norm.
Due to global warming drought won't be measured by duration, but will instead be measured by severity. Just as we have flash floods, we will have flash droughts.
Notice where the Dust Bowl and the 1950s drought fits in. The largest of those gray bars is 66, 75 & 80 years. And notice how the red & blue lines compare to the Palmer Drought Severity Index 0 line. I think that the Kansas 0 line should be here, which means that Kansas has been way more wet than normal this past century.

Drought is a Fact of Life

Figure 7. Synthesis of regional reconstructed PDSI data with additional paleoenvironmental proxy data from geomorphic and archeological sources.

Sand dune movement

1. Arkansas River Valley in SW KS
2. Cimarron River Valley in SW KS
3. Abilene Dune Field in NC KS
4. Great Bend Sand Prairie in SC KS
5. Hutchinson Dunes in SC KS

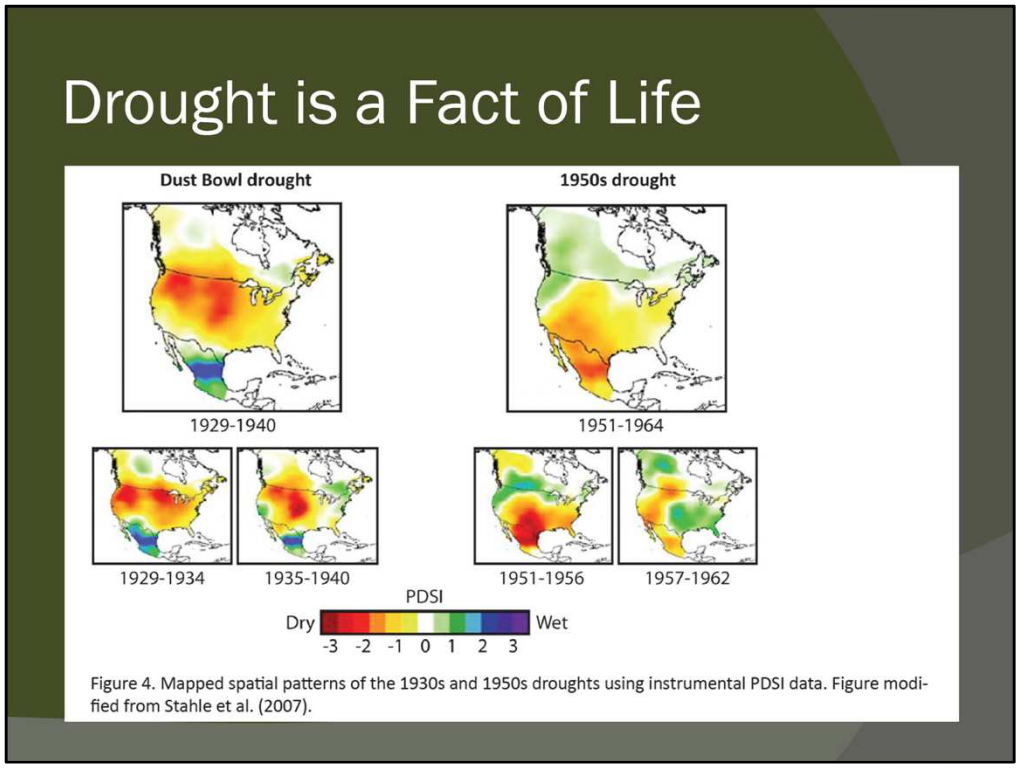
Fremont culture inhabited Utah and parts of Nevada, Idaho and Colorado beginning around CE 700

Anasazi (Chaco Canyon & Mesa Verde) in the 4 corners area (Utah, Arizona, New Mexico & Colorado) began around CE 600 and declined then disappeared in what has been called the “300 year drought”.

The middle Mississippian period ended with the abandonment of Cahokia (in present day Illinois) between 1350 & 1400

Tree ring data shows that the most severe period of a drought coincided with the disappearance of the Roanoke Virginia Colony between 1587 & 1591.

A severe 7-year drought (1605-6 – 1612) decimated Jamestown during the first years of settlement. ½ of the population died due to malnutrition.



We have a 1.4 chance here in SC KS that each year could be the beginning of a drought as severe or worse than those of the 1950s & the 1930s Dust Bowl. That means that we have a 14% chance for that in every 10 years, 54% chance in every 40 years, and if you live all your life in SC Kansas & make it 73 years old, you have a 100% chance of living through a drought as or more severe than those 2 defining droughts.

In NW KS you only have to live there for 47 years to have a 100% chance of a severe drought.
In SW KS its 57 years old.
NC KS its 64 years old
NE KS its 86 years old
SE KS its 129 years old

To Be Drought Resilient Means: Be Prepared

The Right Irrigation Tools

Be Weather Wise

Use Water Wisely

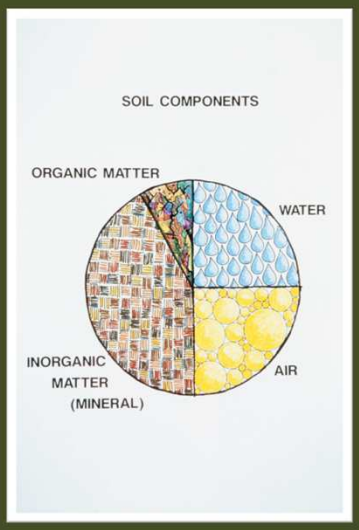
Good Soil

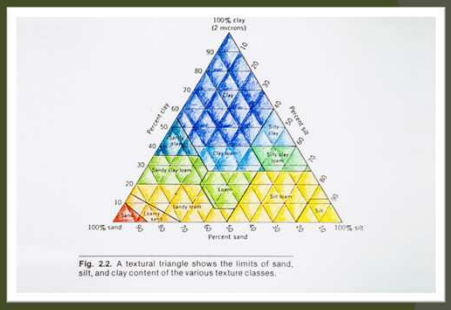
Use Good Plants

Good Soil

There are 1000s of soil types. Some are good, some aren't. Urban soils are especially bad because we treat soil like dirt. We scrap off the top soil or bury it under subsoil. We compact it. We haul off the organic matter. We apply chemicals that kill helpful soil organisms and the death of these little helpers is the collateral damage of our war on pests.

What is Good Soil?





Good soil is a well balanced mixture of inorganic matter, organic matter, water and air. The inorganic matter is determined by the parent rock of the local geology. Here we have limestone & shale because this area was once a shallow inland sea that has been uplifted and then eroded by wind & water. The local soils have a high pH (alkaline a.k.a. base) and once you're away from the river bottom land, then soil is decidedly more clayey.

What's Your Soil Type?

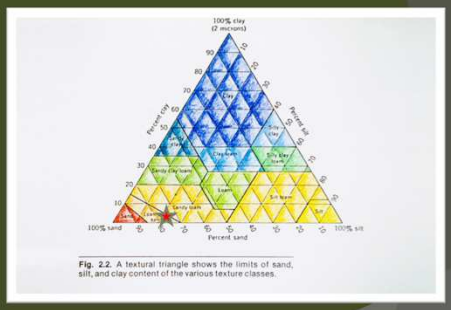


Fig. 2.2. A textural triangle shows the limits of sand, silt, and clay content of the various texture classes.

Sand, silt & clay denote the sizes of soil particles. The best soils are loams, which are a good balance between these 3 sizes of particles. A Jar test is a good way to determine what type of soil you have.

What this tells you is how big are the soil pores…a.k.a. as the space between the soil particles. This lets you know how much water the soil can absorb in a certain amount of time, as well as, how much water the soil will hold/retain after the water is turned off.

2 ¼ inches. 1 ¾ inch sand. ½ inch silt. ¼ inch clay. 77% sand. 22% silt. 11% clay.

A plant's roots are its lungs, stomach, kidneys, liver, pancreas & etc. The top growth (leaves, stems & etc.) are there to make food and for reproduction. Good soil is absolutely imperative for helping a plant be drought tolerant. You want at least 12 inches of good soil because most plant feeder roots are in the top 12 inches of soil.

It also helps to get your soil tested. Sedgwick County Extension has inexpensive (less than $20) soil test that will let you know the nitrogen, phosphorus & potassium levels, as well as, the pH & organic matter levels of your soil.

Getting the best plants is an entire presentation by itself, but I've limited it to one slide. So, a few words about plants.

It takes a bit of research but get a good plant and then treat it right is the key to drought tolerance. A lot of good research has gone into finding hardy plants for south-central KS, so all you have to do is a little research to get lists of fruits, vegetables, annuals, perennials, groundcovers, shrubs, trees and turfgrass that will do well.

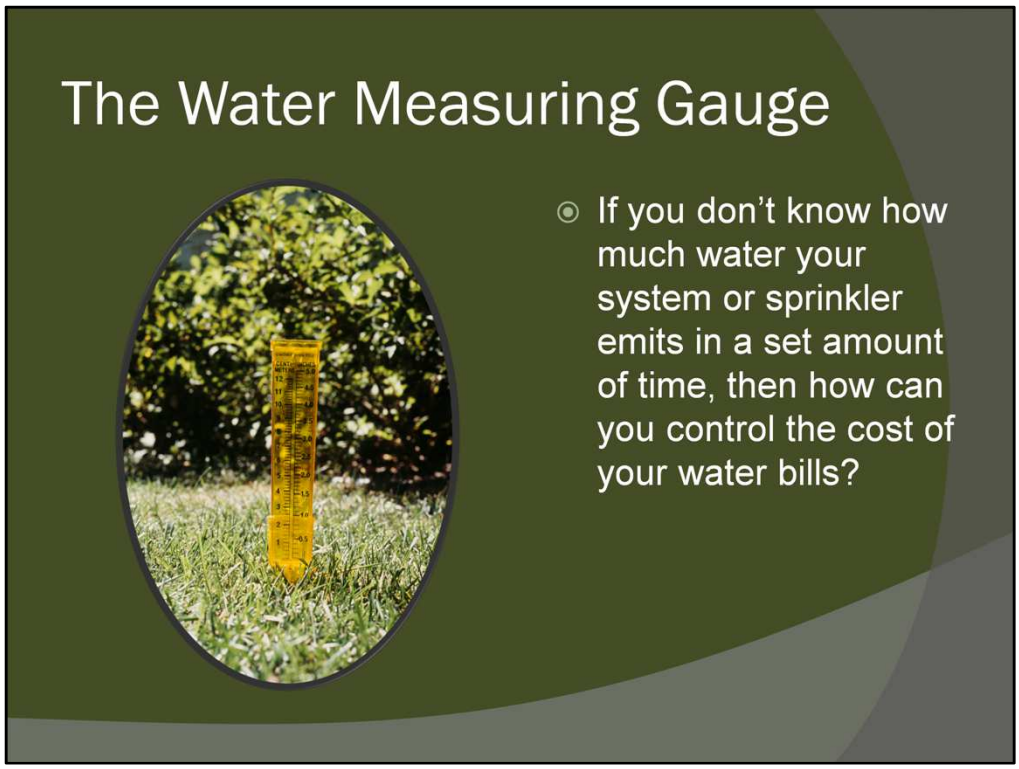
Then learn what each plant needs. Give them the right soil type, nutrients, pH, as well as pay attention to the sun/shade requirements, tolerance to wind, watering requirements, and do not plant it too shallow or too deep & etc.

Group plants with the same likes and dislikes into one area. It will save time, effort and you won't be risking over or under watering.

You can experiment with a plant or two to see how it does in your garden, and it is certainly ok to have a few exotics that you group together & baby along. However, to set out an entire gamble garden is just silly, self defeating and a waste of resources.

The final plant caveat is: No matter how heat or drought tolerant a plant is, they are living things. There are temperatures at which plants stop blooming and stop producing, and all the water in the world will not get a crop or a bloom. You gotta know when to fold 'em. If the plant is a perennial, water only enough to keep it alive. If it is an annual, let it die.

The Right Tools



In a KSU 2010 survey of homeowners in Olathe, Salina and Wichita 74% did not know how much water put down each time they irrigated
When asked how much water their lawn needs 20% said that it was greater than 2-inches. 62% did not know.

You cannot be conservative with water until you have this critical piece of data. How much water do you use?

1 inch on 5000 sq. ft. = 3117 gallons Do that once a week for one month and it will cost you $68.45
Hands on demo time.

Water deeply and infrequently

Use Efficient Sprinklers

Evaporation is Nature's Tax on Water Tossed into the Air

Good Sprinklers have Coarse Drops & a Horizontal Spray

A misting sprinkler is a wasteful sprinkler

The right irrigation tools are as important as a good shovel or a sturdy trowel. A bad sprinkler will waste your water & your time & create problems for your plants.

Drip irrigation and micro-spray irrigation are the best for gardens. The only plant that has to be watered by a large spray head is turf grass. Drip irrigation was created for growing row crops, but it has worked very well in shrub and perennial beds.

It is easy to use, and can be configured to fit a lot of different garden circumstances. It is also easy to figure out how much water you're using. Just add the gallons per hour together & multiply by the hours the drip system is run.

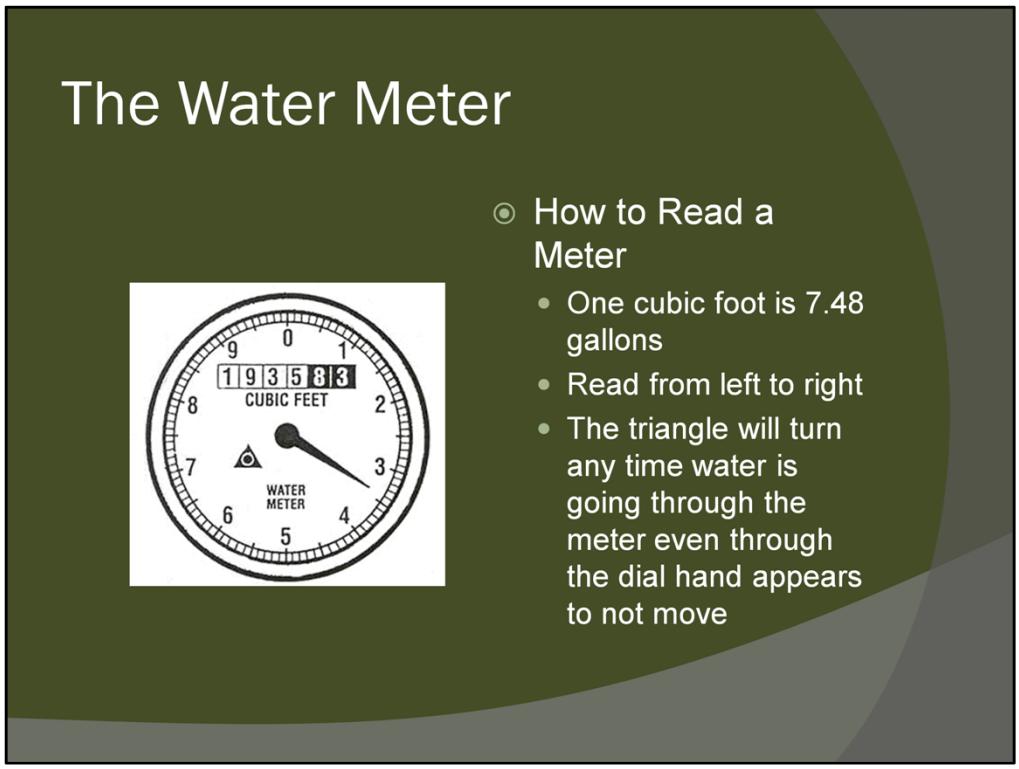
The goal of irrigation is to fill up the soil reservoir so that you don't' have to water again for several days. How do you know you've filled the reservoir? Don't guess. Use some tools to see just how far into the ground the water has penetrated.

Soil probe/core puller
Long screw driver
A piece of rebar
Soil moisture sensor
A shovel

Once you know how much water the sprinkler or drip irrigation is putting out over a set period of time, then get a timer or a clock to so that you water for just the amount of time needed to fill the soil reservoir.
Battery, hard wired, remote, spring-loaded…there is a tremendous range in timers and irrigation clocks. If you're not using this tool then you're probably wasting water. Even hose pullers should use a kitchen timer. I use the one on my stove. It's loud and obnoxious and a great reminder to go out & move the sprinkler.

Don't set it & forget it. That's a waste of your money. If you don't know how to program your irrigation clock…learn. Consider the water you'll save as the benefit for the cost of your time to do this. Go on-line. Call an irrigation company. You need to be able to change your clock at least monthly so as to keep up with the weather. Changing your timer every 2 weeks is best. Best of all, track ET and then set the clock to go off early the next morning, but otherwise keep it turned off.

And, if your clock is more than 10-years old, replace it. Get one of the clocks that tracks ET and will water according to that.



If you don't want to use the rain gauge or the can method of figuring out how much water you use, then use the water meter.

Folks with AMR: BE VERY CAREFUL when removing the meter lid. If the equipment is tampered with or damaged you can be assessed a fee up to $100. So, don't yank on the wires, and just set the lid over gently. Then you can read the meter below. Look for spiders and avoid these. Take a flashlight. A large flat head screw driver works well to pry up the lid. If the meter vault is full of water, bail it out. It is often a sign of lawn over watering. It may also be a sign of a leak at or near the meter.

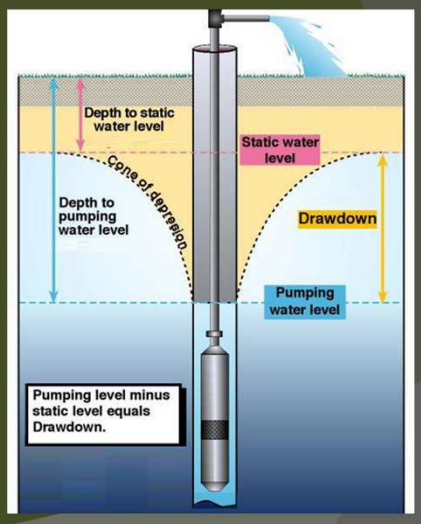
Each revolution of the hand = 7.48 gallons (recorded in the first right hand dial). So, if this were a new meter with all 0s, then after 1 revolution of the hand, a 1 would appear in the far right hand column. That would be 7.48 gals. If the reading was 10 (for 10 revolutions of the hand) then 74.8 gallons have passed through the meter.

1,448,000gallons have gone through this meter.

To find out how much you're using for irrigation, read the meter before you turn the sprinkler or the irrigation system on. Then read the meter after you're done. Subtract the first reading from the second one and multiply by 7.48. That will get you the number of gallons used.

Good Water Quality

- Always test water before using it for the 1st time
- Test irrigation water quality every 5 years
- Do not use water with a high sodium content



A lot of people are putting in wells so as to avoid increasing water costs. This is good because drinking water really shouldn't be used for watering the lawn and garden. However, it comes with its own set of problems.
It is finite. Too many straws in the aquifer can lead to water degradation or even the level being pulled down to where the well can no longer suck it out.
Remember what I said earlier about the area having once been an ocean?
Also…Ever heard of what Rome did to Carthage after conquering it?

This part of the USA was once an inland sea and so water that is high in salt is common. The Big Arkansas has a fairly high saline content due to the back ground salt of the area, plus that fact that sewage treatment plants do not remove salts.

Salt is left behind as the water evaporates.

Sodium destroys a soil's structure by binding to the soil particles and creating poor drainage (hard pans). This shows up especially during times of drought when there hasn't been enough rain to leach out the salt. It is also a bigger problem with fine textures soils (silts & clays) than with coarser textured soils (sand)

Chloride is toxic to some plants

The amount of aquifer water use during years of drought can lead to a draw down of the over all groundwater and result in a poorer quality of water being pumped. This is especially common in Wichita.

The amount of gypsum it takes to restore a soil that has been damaged by salt far out weighs the cost of watering with City of Wichita water.

Well water tests can be obtained from Sedgwick County Extension.

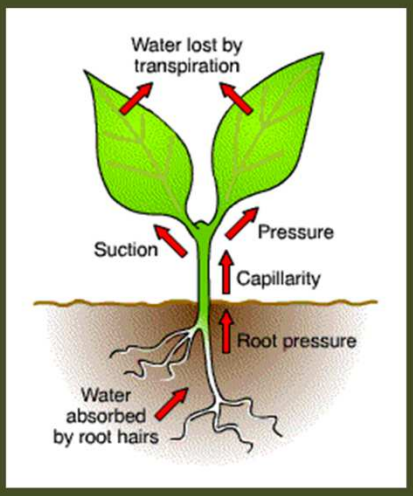
Maintenance, Maintenance & More Maintenance

- Repair or replace worn irrigation sprinklers, hoses, couplings & etc.
- Audit the drip system once a season
  - Clogged or missing emitters
  - Clean or replace filters
  - Make sure that connections are tight
  - Check rain sensor, clock and cross connection control for proper function

Use Water Wisely

This man has the best intentions…
The key to good watering is to do it deeply and infrequently. You cannot do that by standing in the garden patch with a hose. This guy doesn't even have a hose end sprayer shut off. I wonder how much water he wastes as he saunters over to close the spigot?

Water & the Plant



- Moves nutrients and required for photosynthesis
- Water transported by transpiration
  - Driven by evaporation into the atmosphere
- Water availability
  - Soil moisture
  - Soil type
- Water the root-zone
  - 1-inch per week
  - Crop dependent

We respire. Plants transpire.

Why plants need water.

Water According to Soil Type and Plant Needs

Water-Holding Capacity and Availability in Different Soil Textures

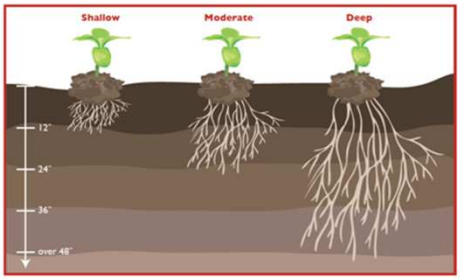
	Coarse Soils (Sand)	Mixed Coarse / Fine Soils (Loam)	Fine Soils (Clay)
Water available (gal / cu ft)	½ gal	1 gal	1½
Depth 1" of water penetrates	24"	16"	11"
Infiltration in 1 hour	2"	¾"	¼"

Rooting Depths of Selected Vegetable Crops

Shallow (under 24")		Moderate (36–48")		Deep (over 48")	
Broccoli	Cabbage	Beans	Beet	Asparagus	Winter squash
Cauliflower	Corn	Carrot	Cucumber	Tomatoes	Sweet potato
Lettuce	Potato	Peas	Peppers	Pumpkin	Watermelon
Radishes	Spinach	Summer squash			
Turnip					

Periods of Critical Water Needs in Crops' Life Cycle

Stage	Crop
Germination	Seedlings—especially summer and fall crops
Pod enlargement	Beans, peas
Head development	Cabbage, broccoli, cauliflower
Root enlargement	Carrot, onion, potato, radish
Flowering to early fruit set	Corn, cucumbers, squash
Early fruit development	Melons
Uniform all season	Tomatoes, peppers, eggplant

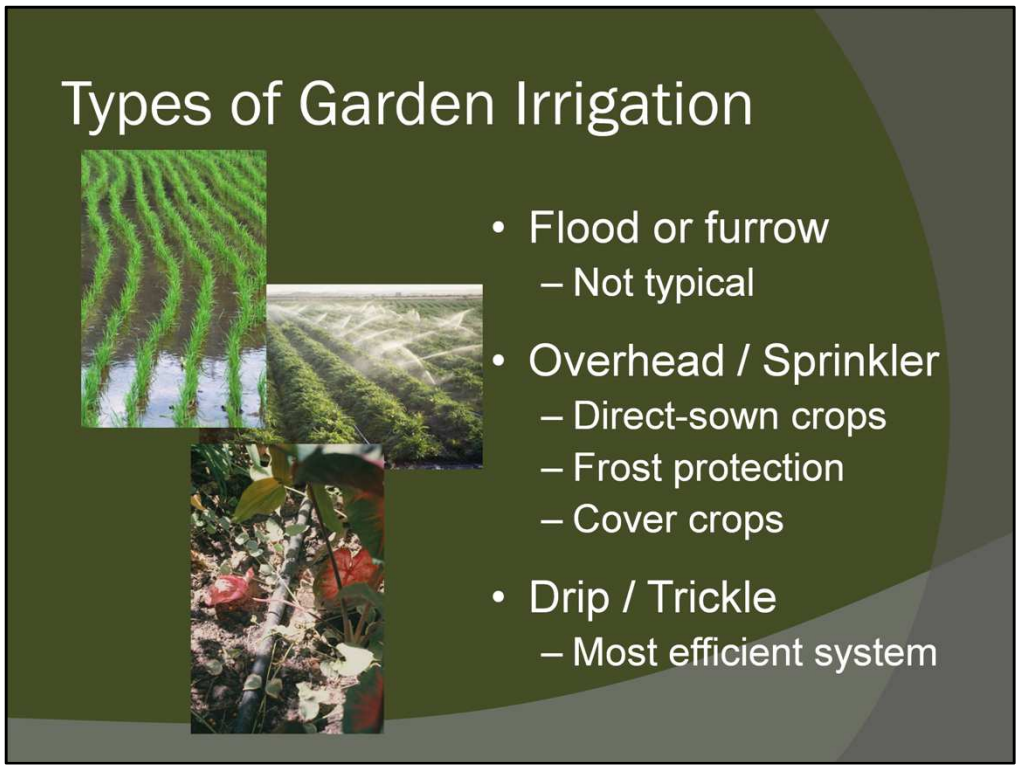


Always water the **ROOT ZONE**

Here's where that info about soil I gave you previously comes in handy.
How deep is the soil reservoir? How fast does water infiltrate the soil?

Coarse soils (sand) let the water soak in quickly but don't hold a lot of water. Water a bit more often (add that compost – it's like little sponges)

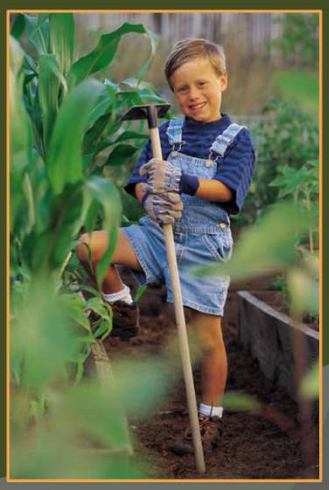
Tight soils (clays) absorb water slowly but hold more of it. Soak and cycle if necessary with tight soils (add that compost – it opens up pore spaces)



As discussed earlier, there are many ways to irrigate. It's up to you to choose the most efficient way for your garden needs at any point in time. Remember, your garden will change over time and you have to make the irrigation type match.

Ten Ways to Water Wisely

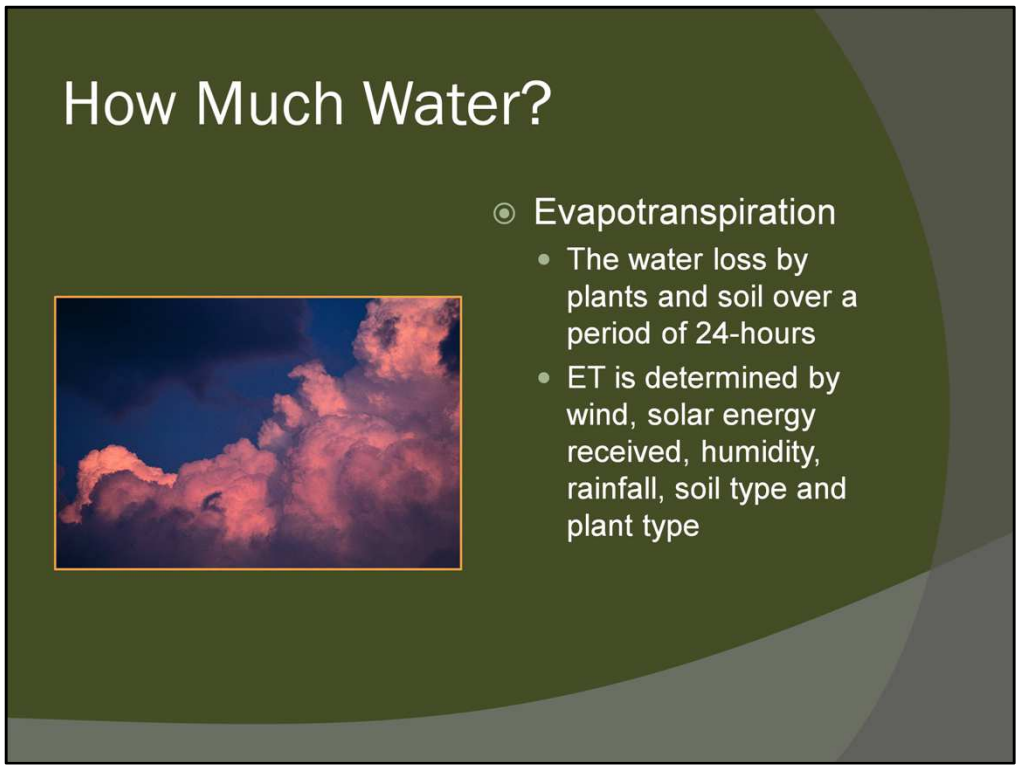
- Water deeply, but no deeper than the root zone
- Water slowly. Reduce the flow
- Water infrequently, but thoroughly & deeply
- Loosen the soil/mulch surface to keep it receptive to water absorption
- Check irrigation system regularly for leaks, etc. (maintenance, maintenance, maintenance)



Ten Ways to Water Wisely

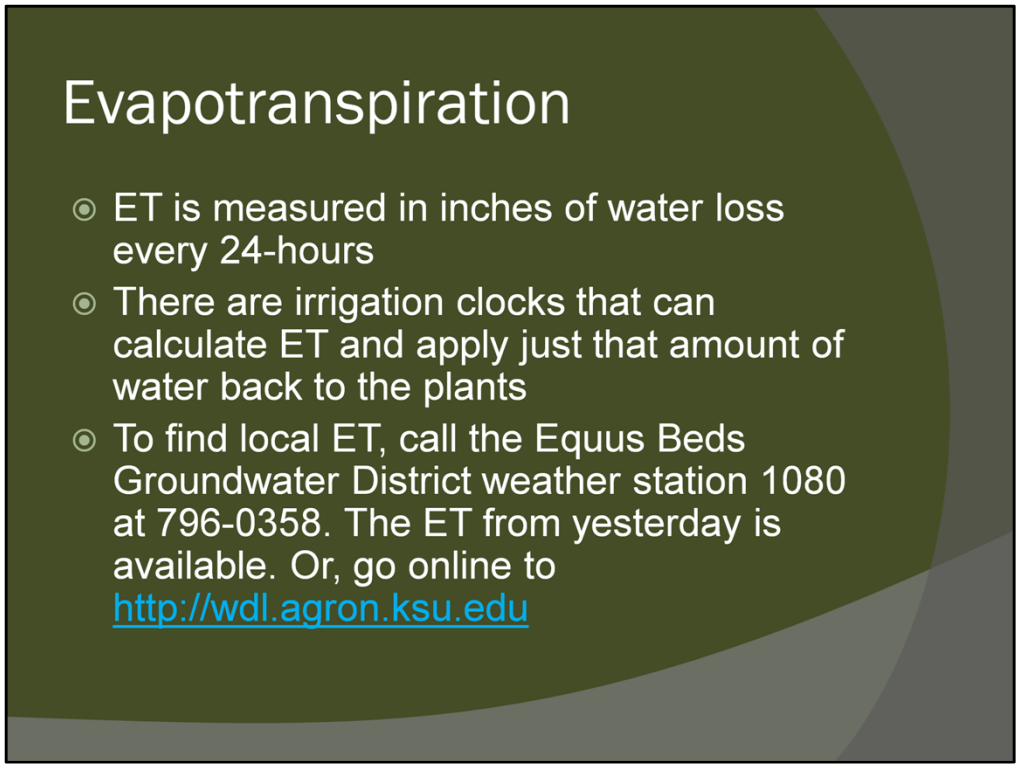
- Keep your garden free of weeds (competitors)
- Reduce evaporation from (bare) soil - Mulch
- Avoid watering during windy weather (overhead)
- Water early in the morning when humidity is highest to reduce evaporation
- Locate the garden away from trees that might compete for water

You've heard the saying, "If you don't like the weather, wait 5 minutes. It'll change." It's true!!!



We can't change the weather, but we can pay attention to it. And there is a tool that let's you do just that.

This word is a mash-up between the words Evaporation and Transpiration. Evapotranspiration is the 24-hour loss due to water evaporation from the soil and plants water loss from transpiration. Humans respire and plants transpire.



ET is determined by mathematical formula from actual weather and plant data measurements.

You can find local ET through the Kansas Groundwater District #2 which has seven weather stations located throughout Sedgwick, Reno, Harvey and McPherson counties. The one closest to Wichita is "East Sedgwick" by Valley Center, which is close enough to be accurate for Wichita use. The other nice thing about the Equus Beds weather stations is that the ET given is for well watered tall fescue.

Enter the station ID (a pull down list) which is GMD#2 & click on east Sedgwick. Set the dates for which you want data and click on submit query.

You return the amount of water lost at a rate that the soil can absorb and at a the point in time that the grass needs it.

To use ET correctly you have to subtract the amount of precipitation received. You also have to know how much water your irrigation methods put out over a set period of time. We discussed that earlier and I have a hand out. Amounts of rain in increments of 0.2 inches or smaller are not useable amounts. It mostly evaporates. Anything that is ¼ inch or greater is an amount that will soak in and plants can use.

Thank You for Listening!

Kay Drennen
Environmental Specialist, Water Resources Conservation
City of Wichita
Public Works & Utilities Department
Environmental Health Division
W.A.T.E.R.Center
101 E. Pawnee
Wichita, KS 67211
316-350-3387
kdrennen@wichita.gov