Managing trees during drought

Igor Lacan
ilacan@ucanr.edu

With slides from
Dennis Pittenger, UCCE

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Agriculture and Natural Resources
Cooperative Extension

WWW.WOODDECAY.ORG

Help us explore the links between
wood decay fungi and tree failure,
get the wood from your failed tree analyzed – free!

FIRST: Complete an ITFD Failure form, and send to Igor

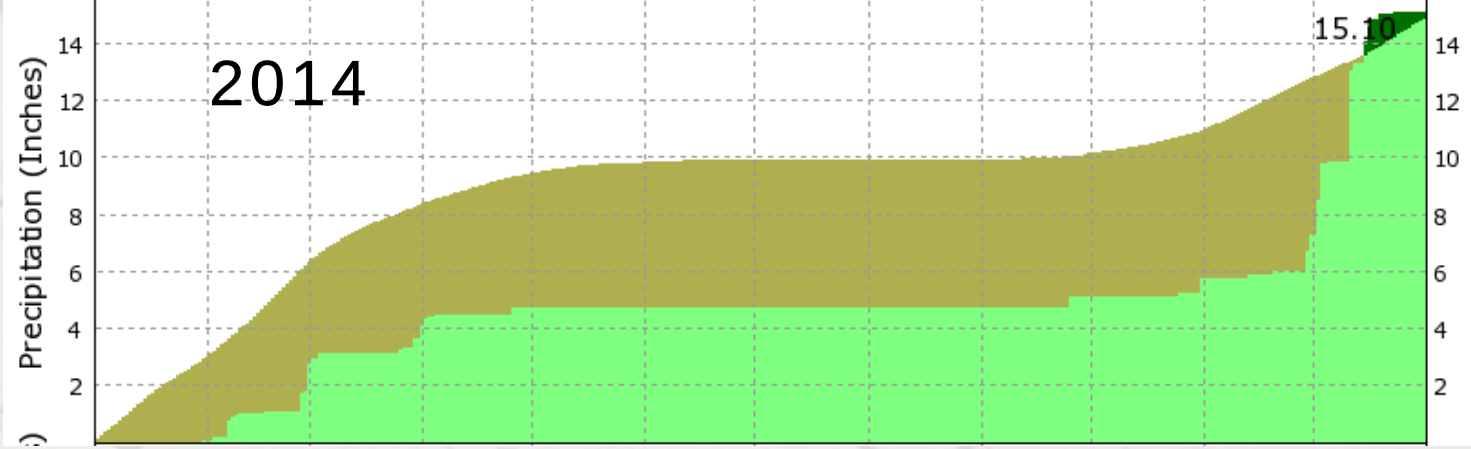
2ND: Send a failed-wood sample to Matteo G.'s lab

3RD: Get results in 6-8 weeks

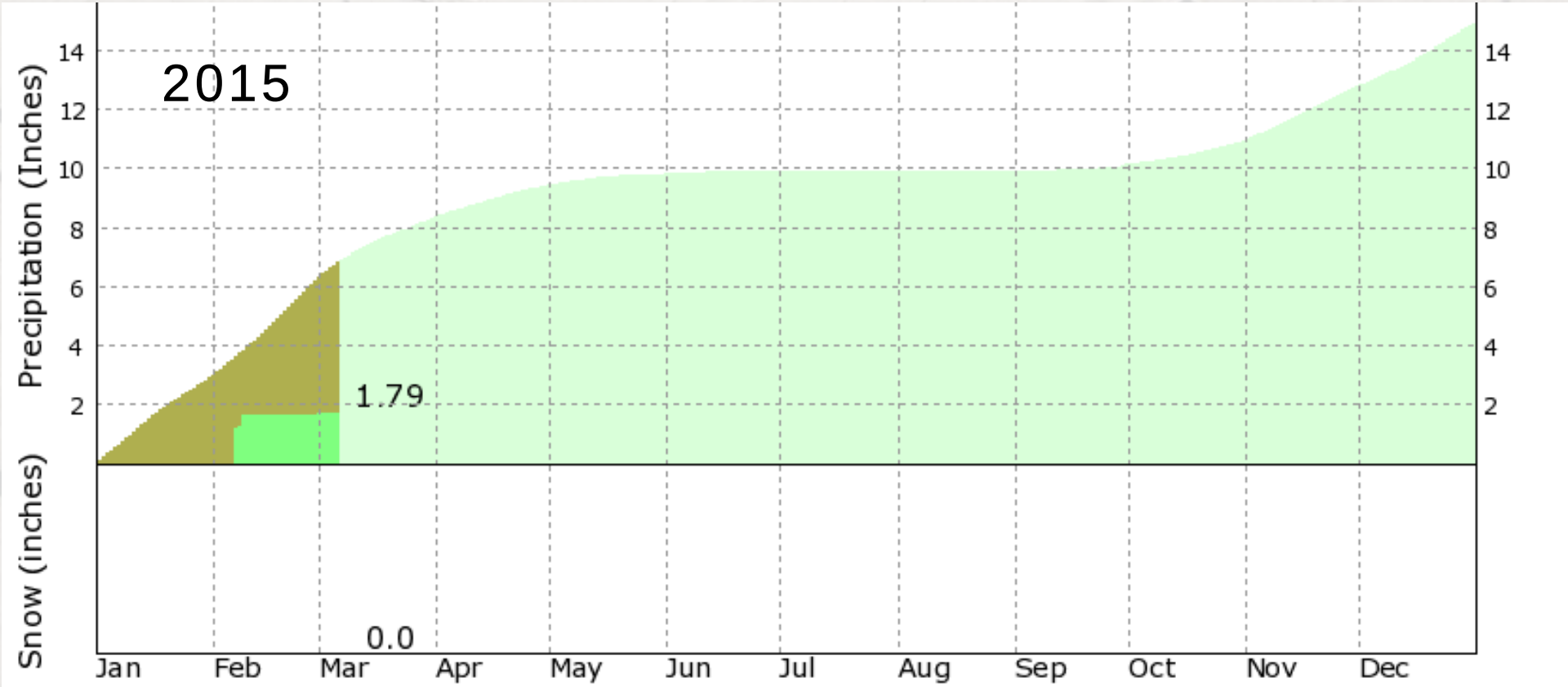
For details, forms, etc., please contact
Igor Laćan ilacan@ucanr.edu
Urban Forestry Advisor 510 684 4323

WWW.WOODDECAY.ORG

Photo: Dr. Larry Costello



Drought…
(www.weather.gov)



Drought:
no magic solutions

Drought points:

1) Understand what is happening in trees and soil

→ **Do not make things worse**

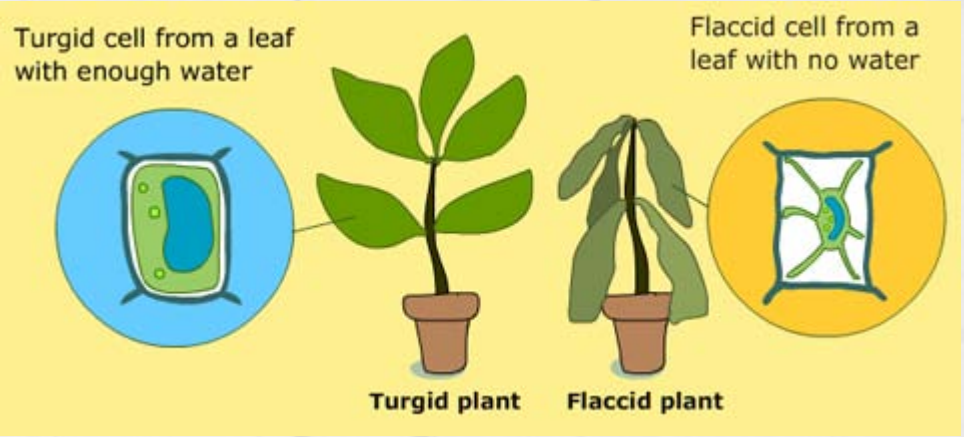
2) Understand your water demand, availability, soils

→ **Then adapt landscapes to drought**

3) Understand your current irrigation system

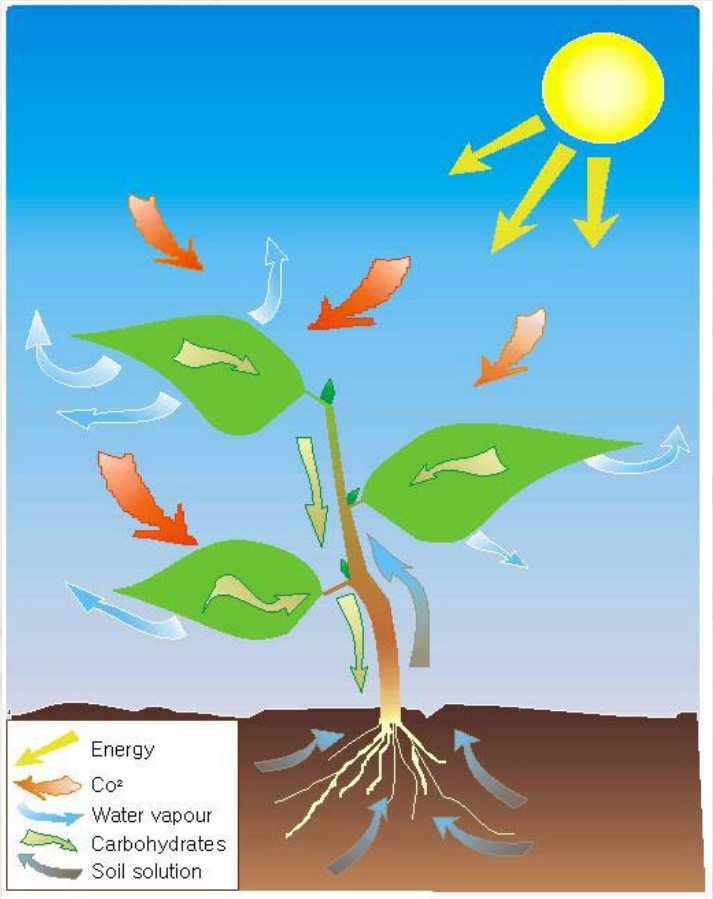
→ **Optimize and/or replace**

Plants need water… but why?

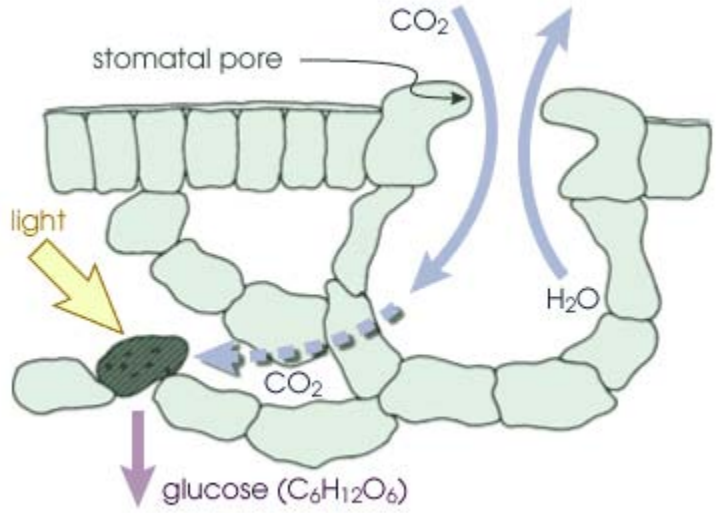


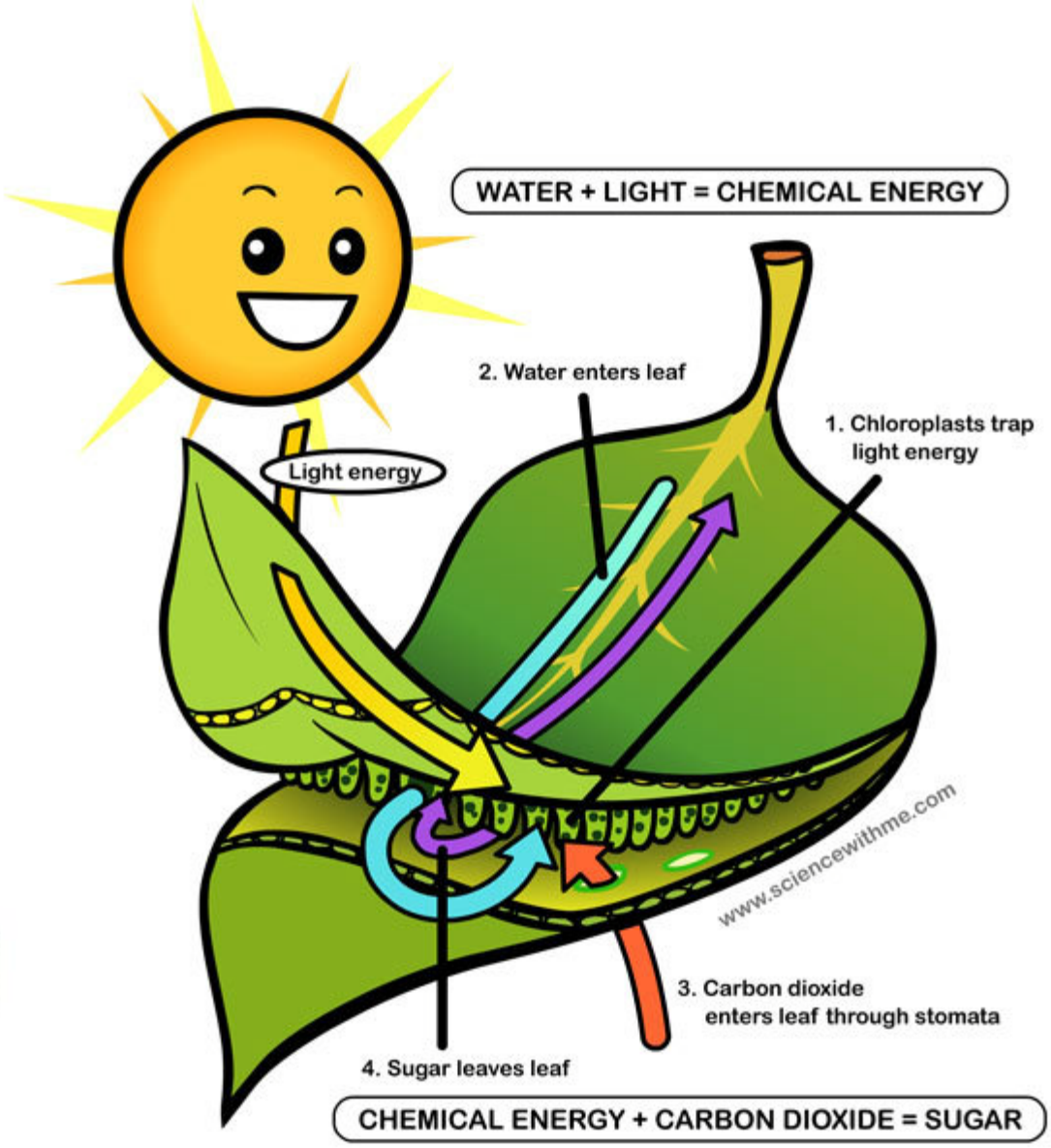
Some uses of water:

1) Turgor
2) Transport of solutes
3) Photosynthesis



Photosynthesis 1: CO_2 in, water out



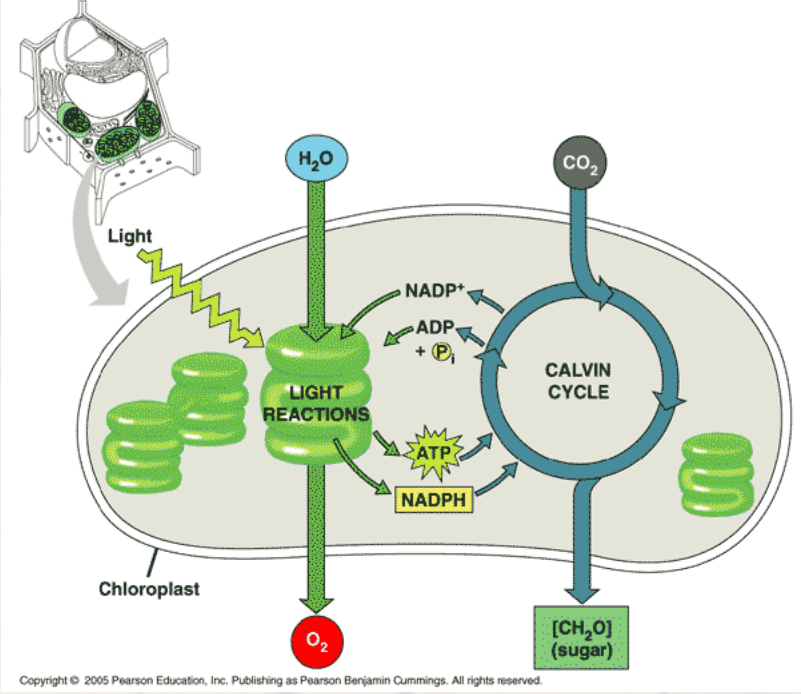


Trees and drought: problematic in several ways…

~ Trees need water to “feed themselves”

~ Drought = overall reduction in growth (which may persist)

Photosynthesis 2:
plants
use water to make food



$$6CO_2 + 12\,H_2O \xrightarrow[\text{plant enzymes}]{\text{LIGHT}} C_6H_{12}O_6 + 6O_2 + 6H_2O$$

six molecules of carbon dioxide

twelve molecules of water

one molecule of glucose (plant biomass)

six molecules of oxygen

six molecules of water

Trees and drought: problematic in several ways…

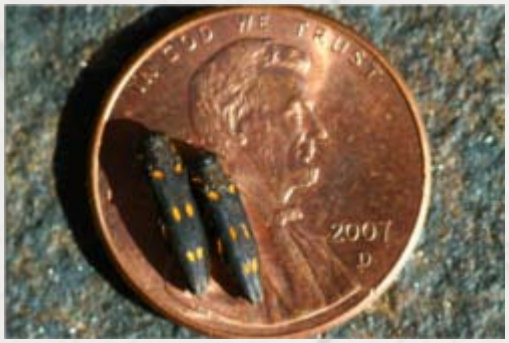
~ Trees need water to “feed themselves”

~ Drought = overall reduction in growth (which may persist)

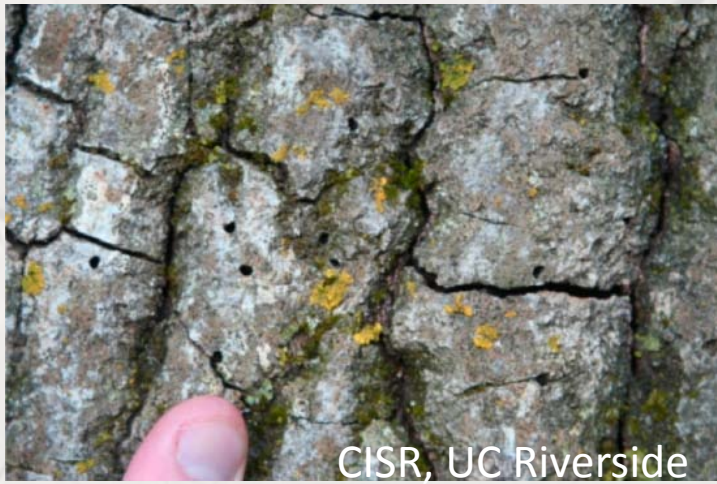
~ Drought = less stored energy = lowered ability to make defensive compounds

Watson and Himelick, 2013

S. California: Goldspotted oak borer *Agrilus auroguttatus*



Host: Live oaks (Coast, Canyon); California black oak
Range: Riverside and San Diego Counties



Thousand cankers disease
Geosmithia morbida

Host: Walnuts (rarely the edible one)
Vector: Walnut Twig Beetle *Pityophthorus juglandis*
Range: CA-wide

How did these pests get here….?

Poster by Ed Lum

Foamy bark canker
Geosmithia pallida

Host: Coast live oak
Vector: western oak bark beetle
Pseudopityophthorus pubipennis
Range: it's here!

Eskalenlab.ucr.edu

Foamy bark canker
Geosmithia pallida

Host: Coast live oak
Management: improve tree condition

S. California:
Polyphagous shothole borer and Fusarium dieback

Range: Los Angeles, Orange, Riverside and San Bernardino Counties

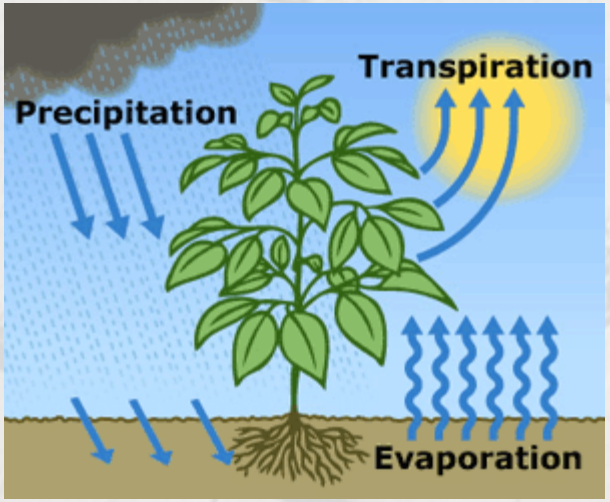
Akif Eskalen,
Eskalenlab.ucr.edu

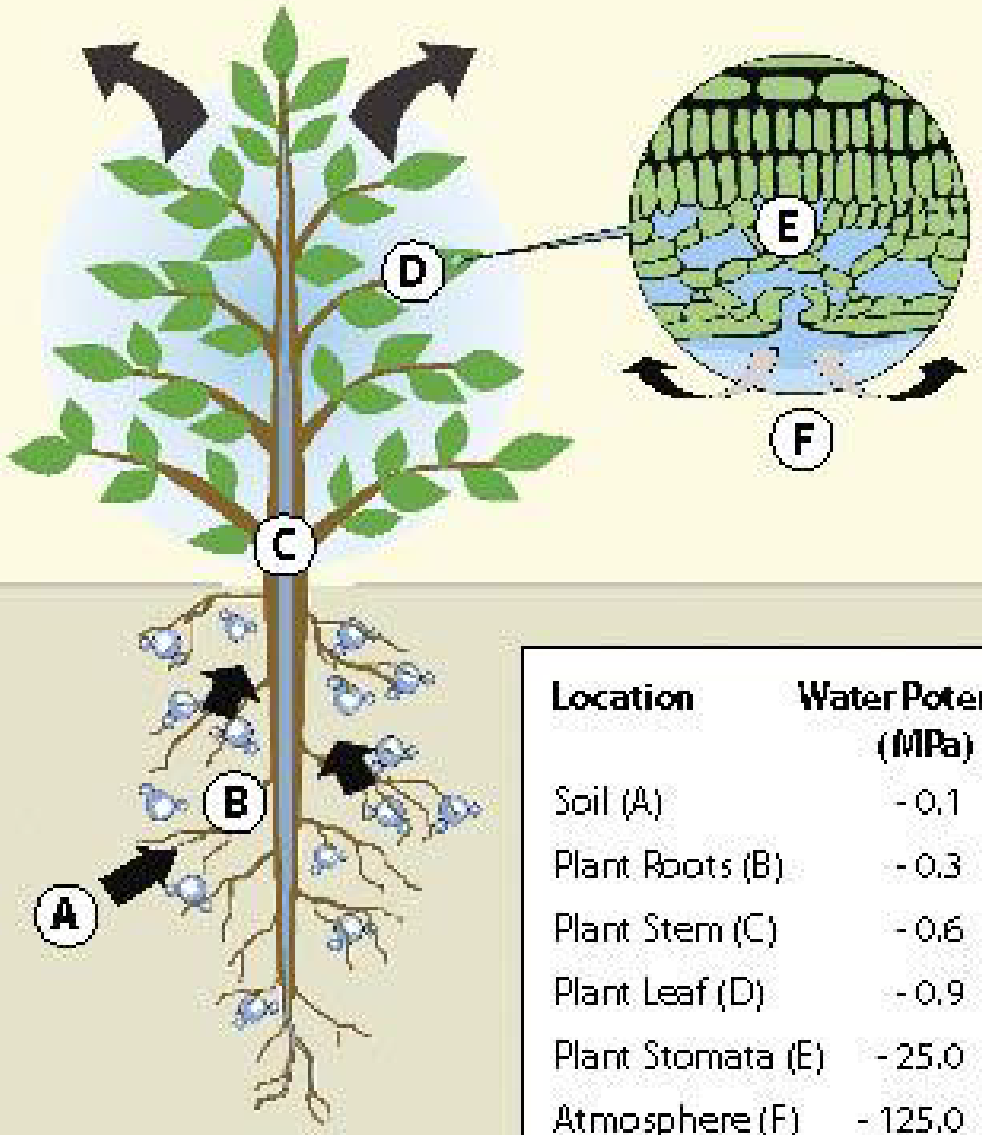
Water in trees: What happens during drought?

Prof Coder says
that during drought trees:

1. recognize ("sense") soil / root water availability problems.
2. chemically alter (osmotic) cell contents.
3. close stomates for longer periods.
4. increase absorbing root production.
5. Use up food storage reserves.
6. close-off or close-down root activities (suberize roots).
7. initiate foliage, branch and/or root senescence.
8. set-up abscission and compartment lines.
9. seal-off (allow to die) and shed tissues / organs unable to maintain health.

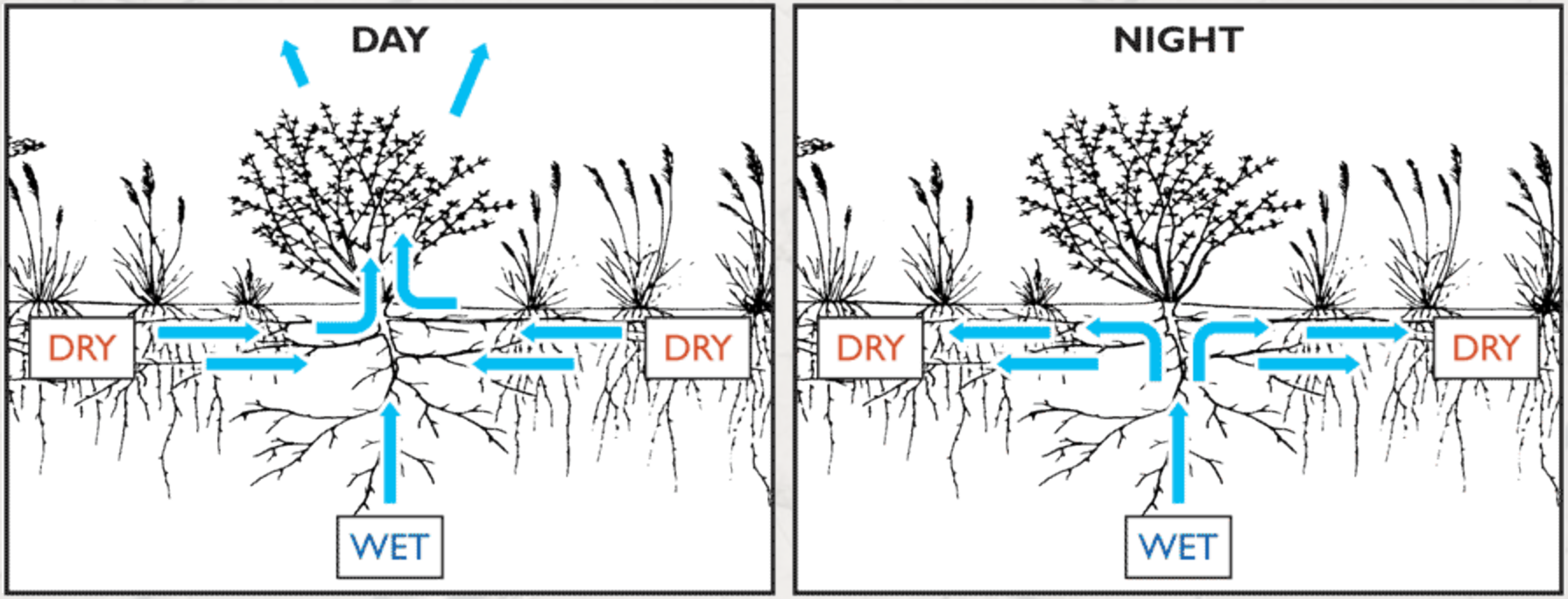
Water in trees: pulled through by evaporation



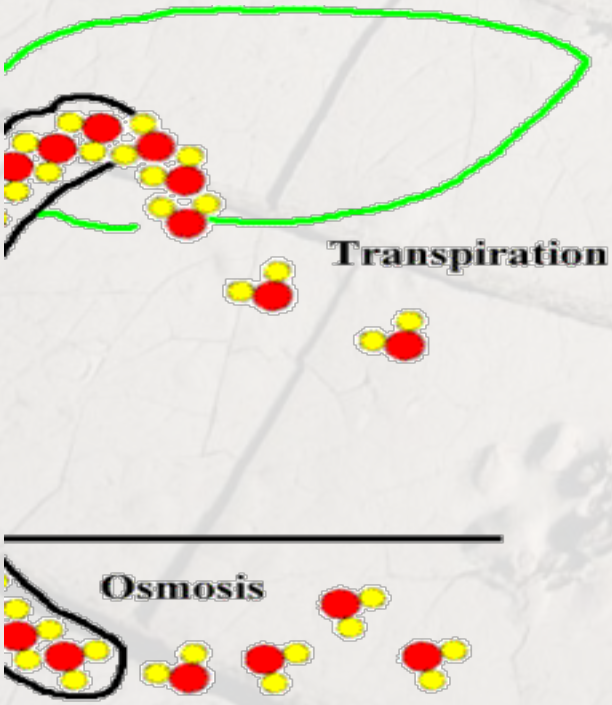


Location	Water Potential (MPa)
Soil (A)	- 0.1
Plant Roots (B)	- 0.3
Plant Stem (C)	- 0.6
Plant Leaf (D)	- 0.9
Plant Stomata (E)	- 25.0
Atmosphere (F)	- 125.0

Hydraulic lift: an opportunity to evaluate the soil water “situation”



Water in trees: the details



Low water potential
Atmosphere ψ: –95.2 MPa
(Changes with humidity; usually very low)

Leaf ψ: –0.8 MPa
(Depends on transpiration rate; low when stomata are open)

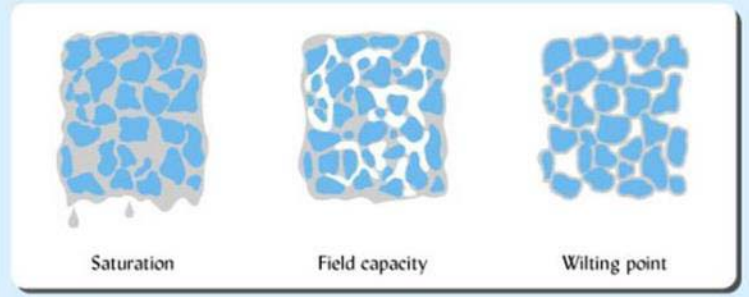
Root ψ: –0.6 MPa
(Medium–high)

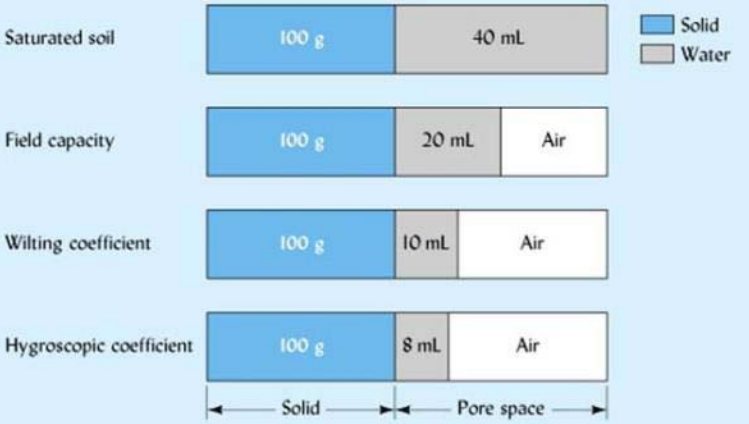
Soil ψ: –0.3 MPa
(High if moist; low if extremely dry)

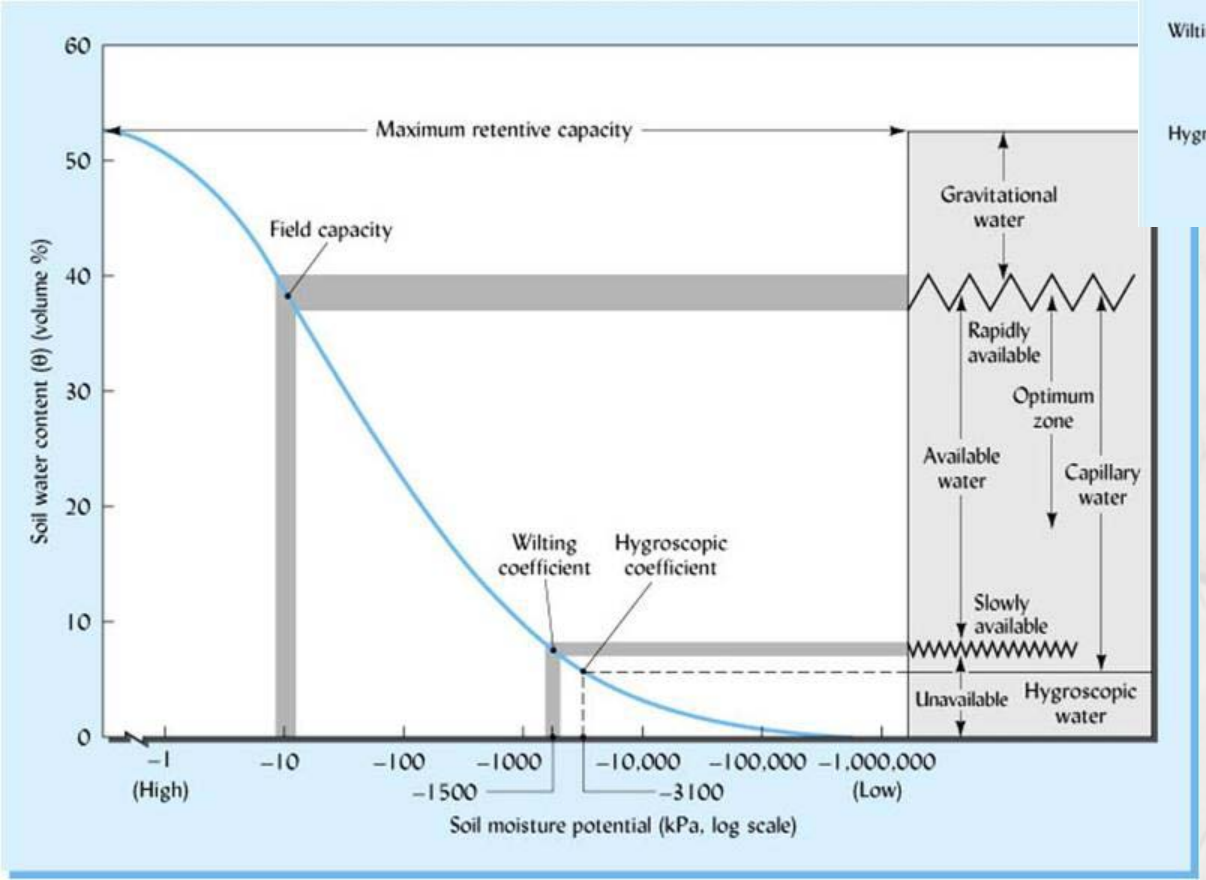
High water potential

Figure 36-3 Biological Science, 2/e

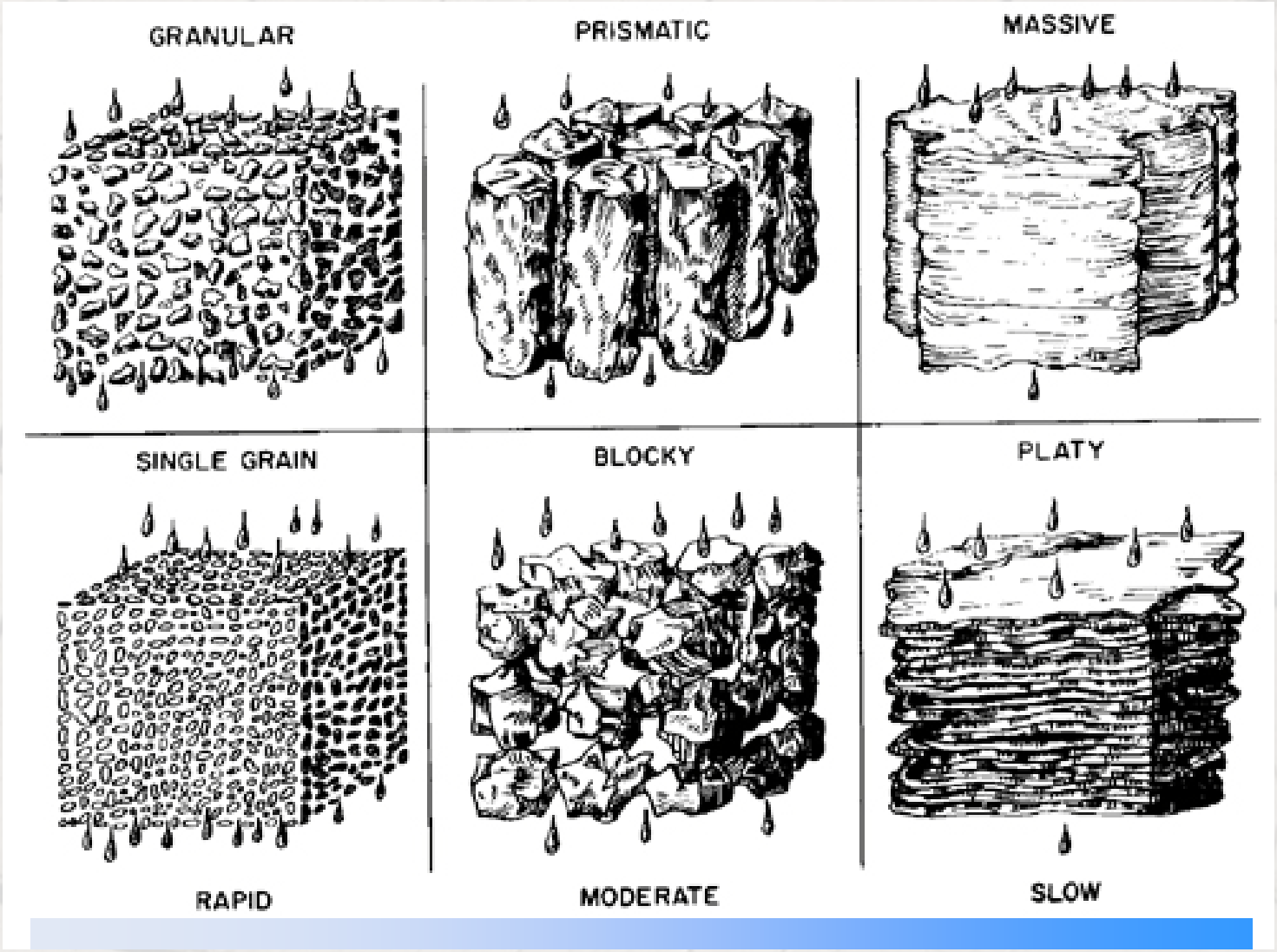
The soil-water-roots system



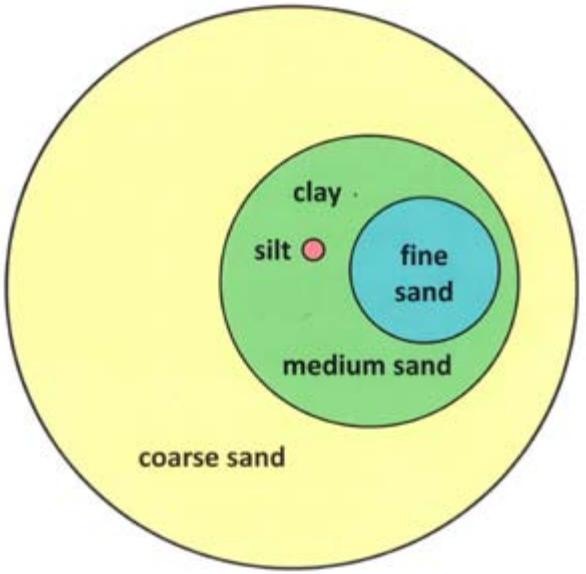


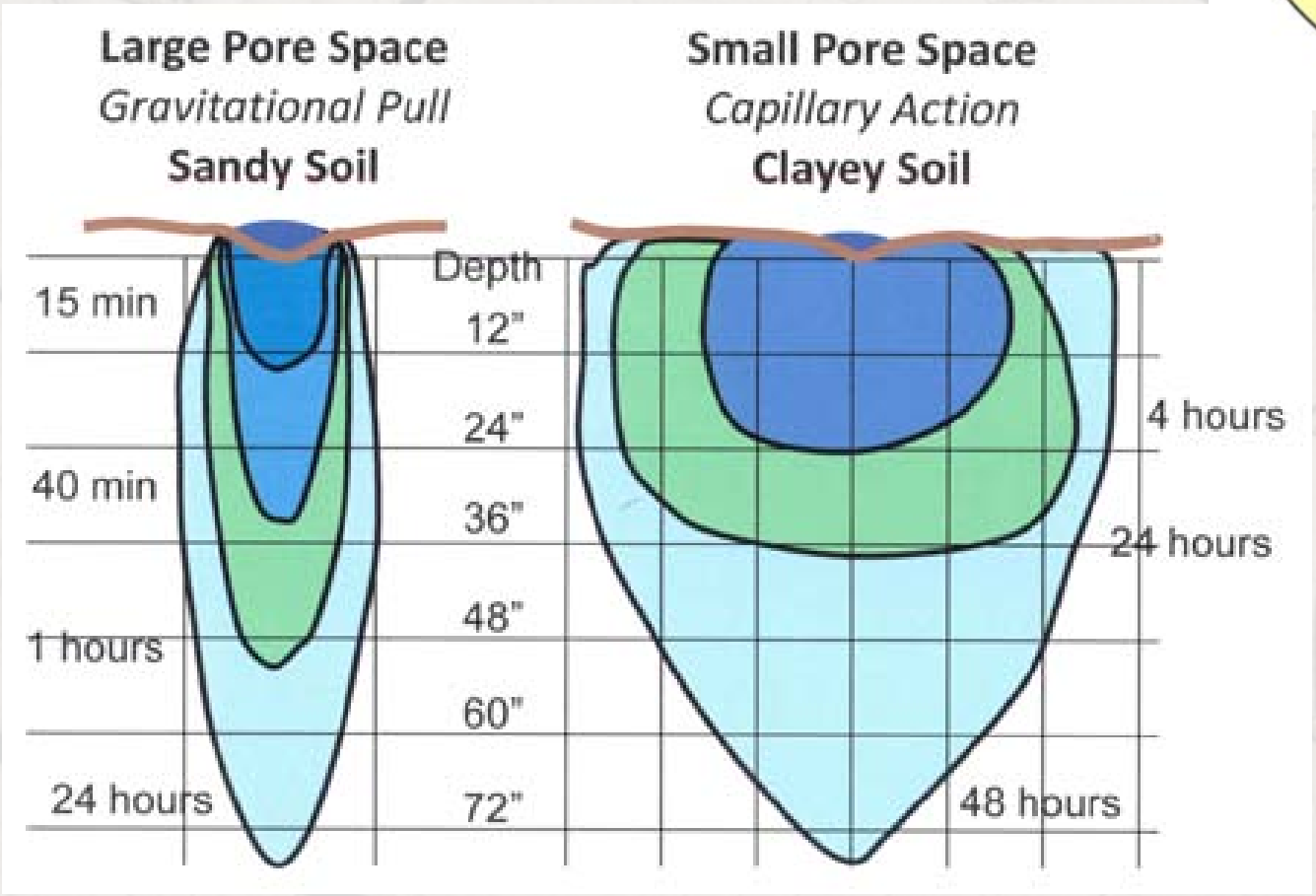


Water movement in soil 1: soil structure (*yes we can*!)

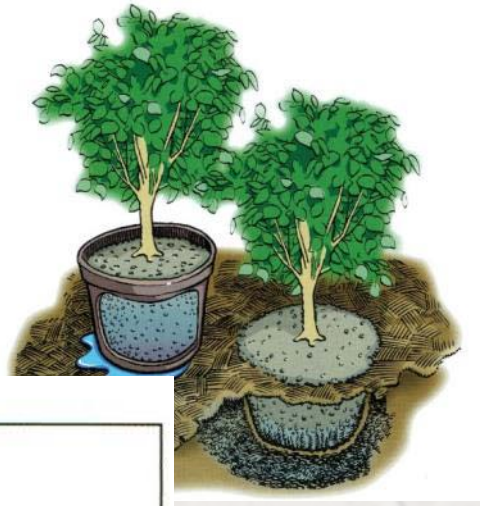


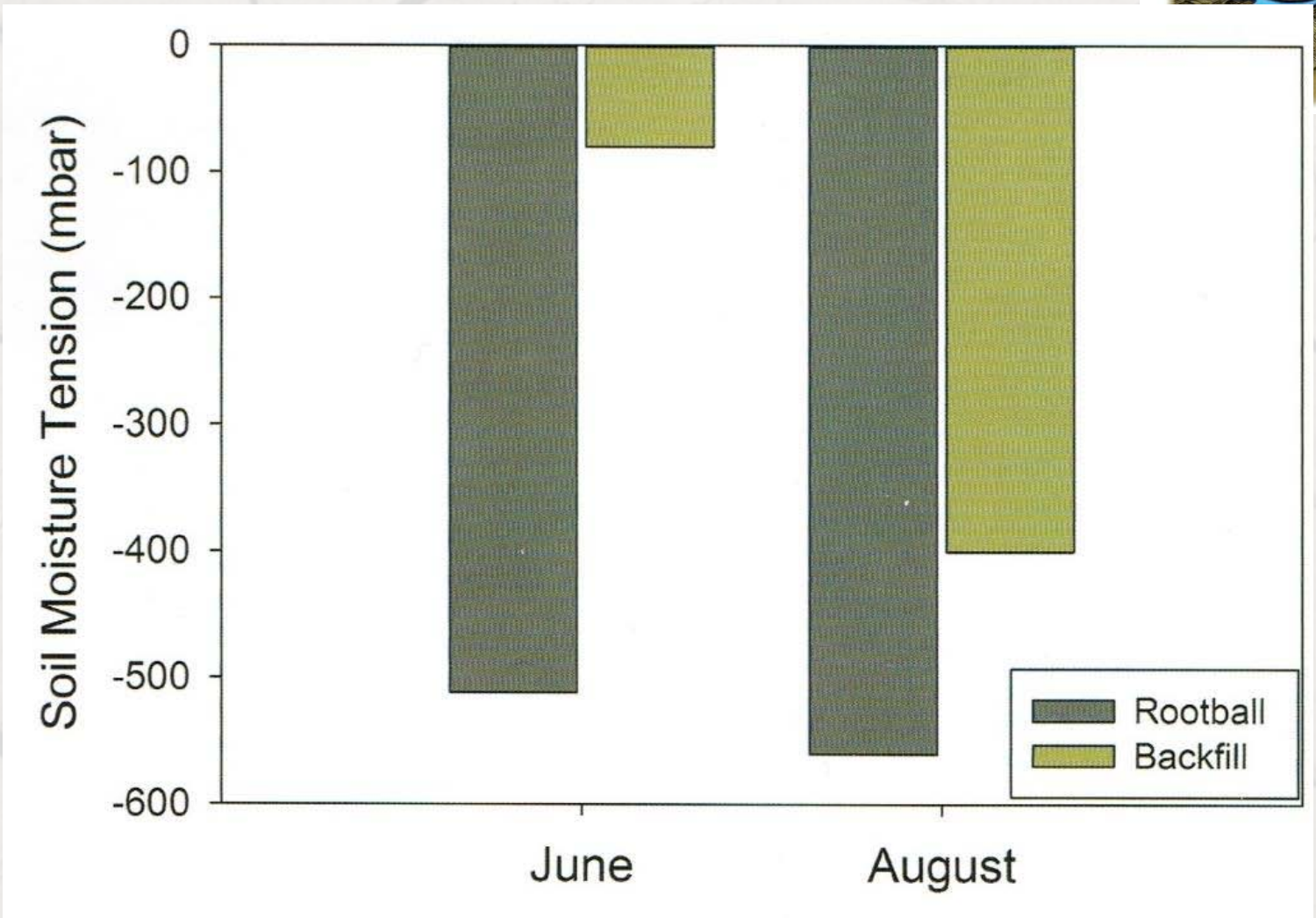
Water movement in soil 2: soil texture





New trees get water
ONLY from the root ball soil
(Suggestion 1: apply water!)



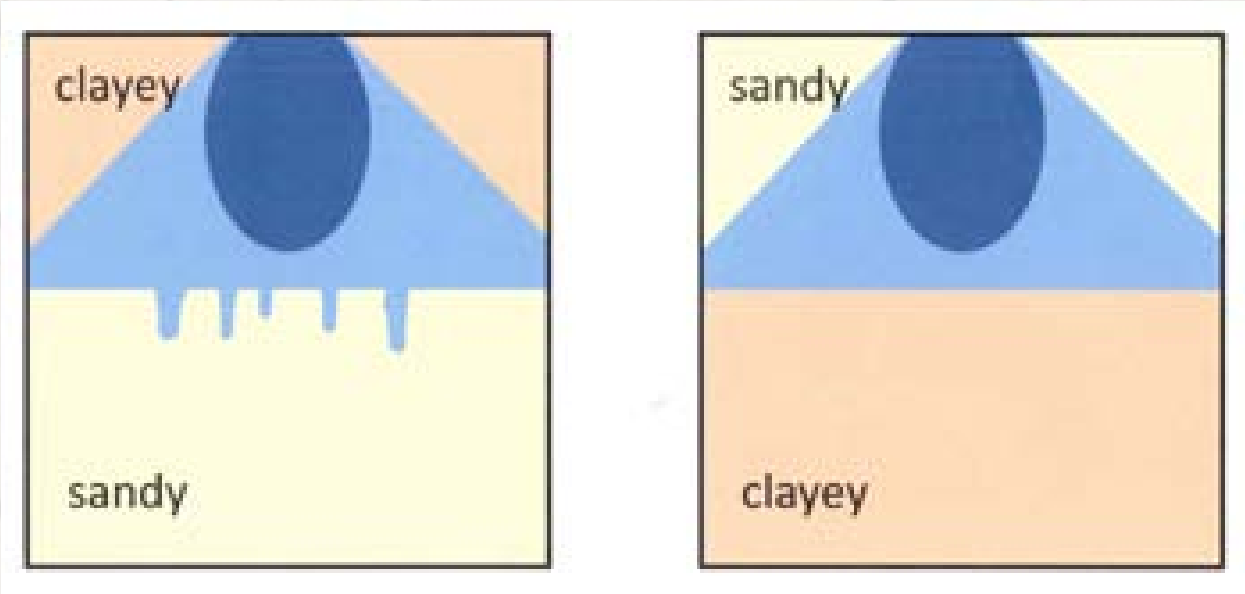


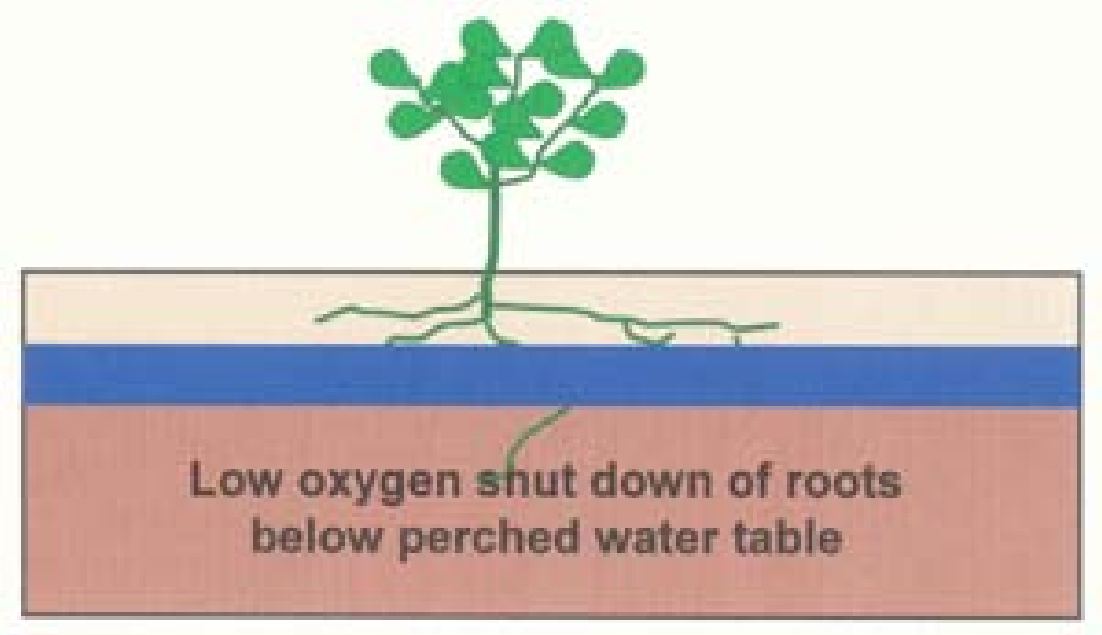
Watson and Himelick, 2013

Suggestion 2:
Plant a smal(er) tree during drought

Watson and Himelick, 2013

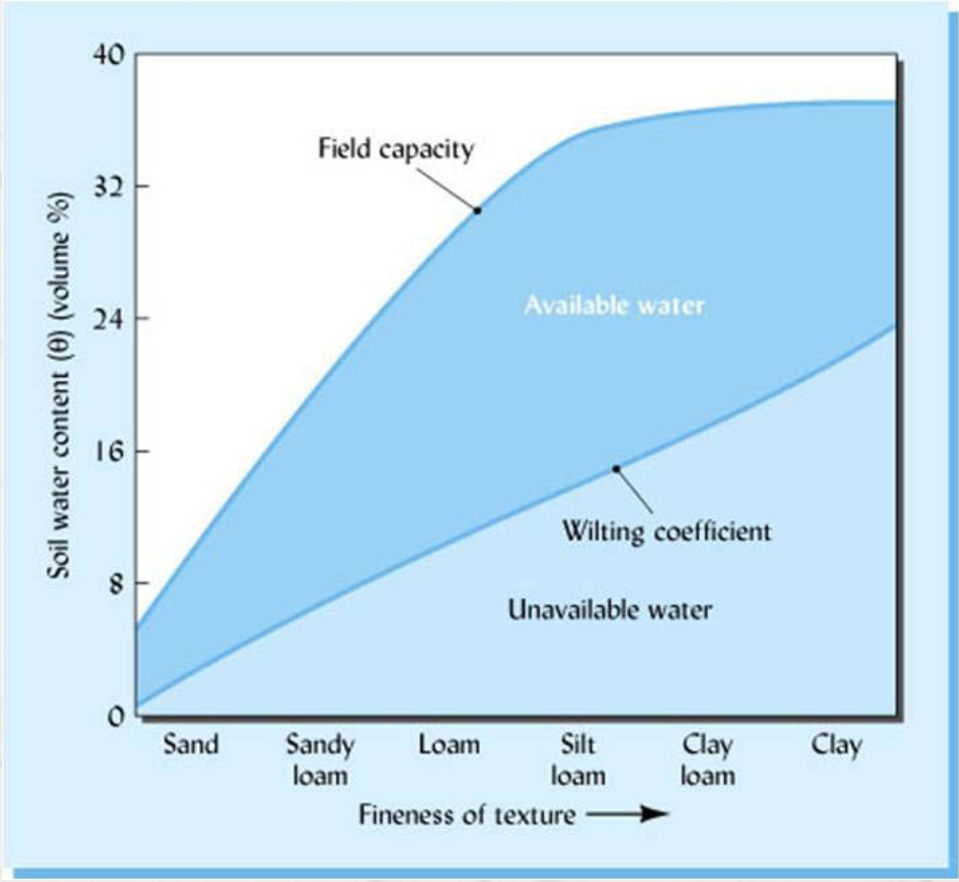
Water movement 3:
Watch out
for changes
in soil texture!

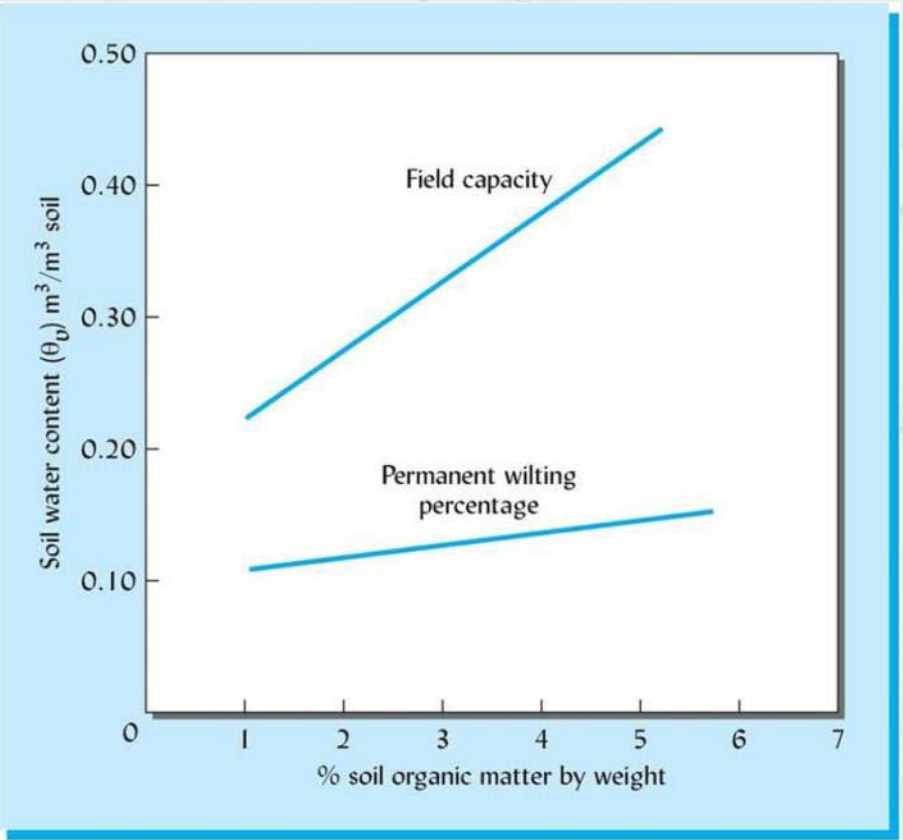




Soil texture difference:
watch out!

Water-holding capacity varies with soil texture and organic matter



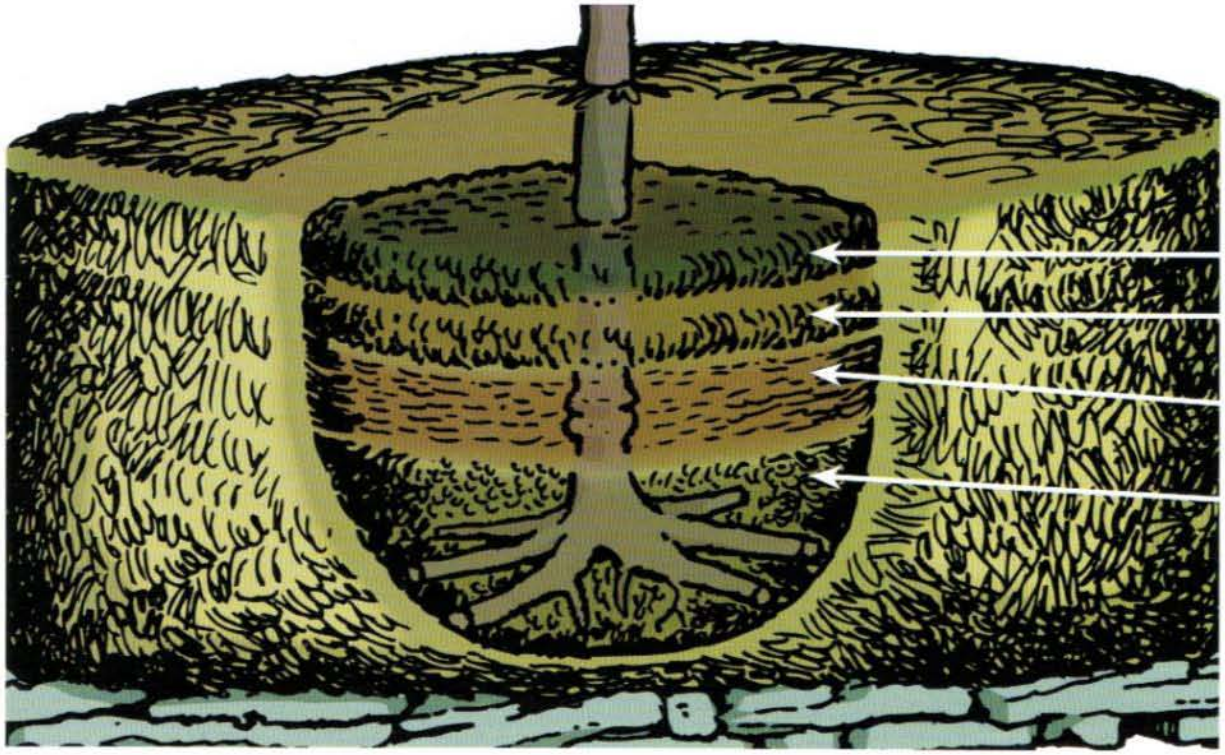


Mulch!

← Tree roots do better under mulch

Mulch pitfalls: volcanoes

Easily avoided problem: tree planted too deep



Watson and Himelick, 2013

Sooner or later, it is going to rain… and that's when pathogens ("rot") will strike…!

...performance expectations
adaptation to precipit

Expectations and Design
determine landscape wat

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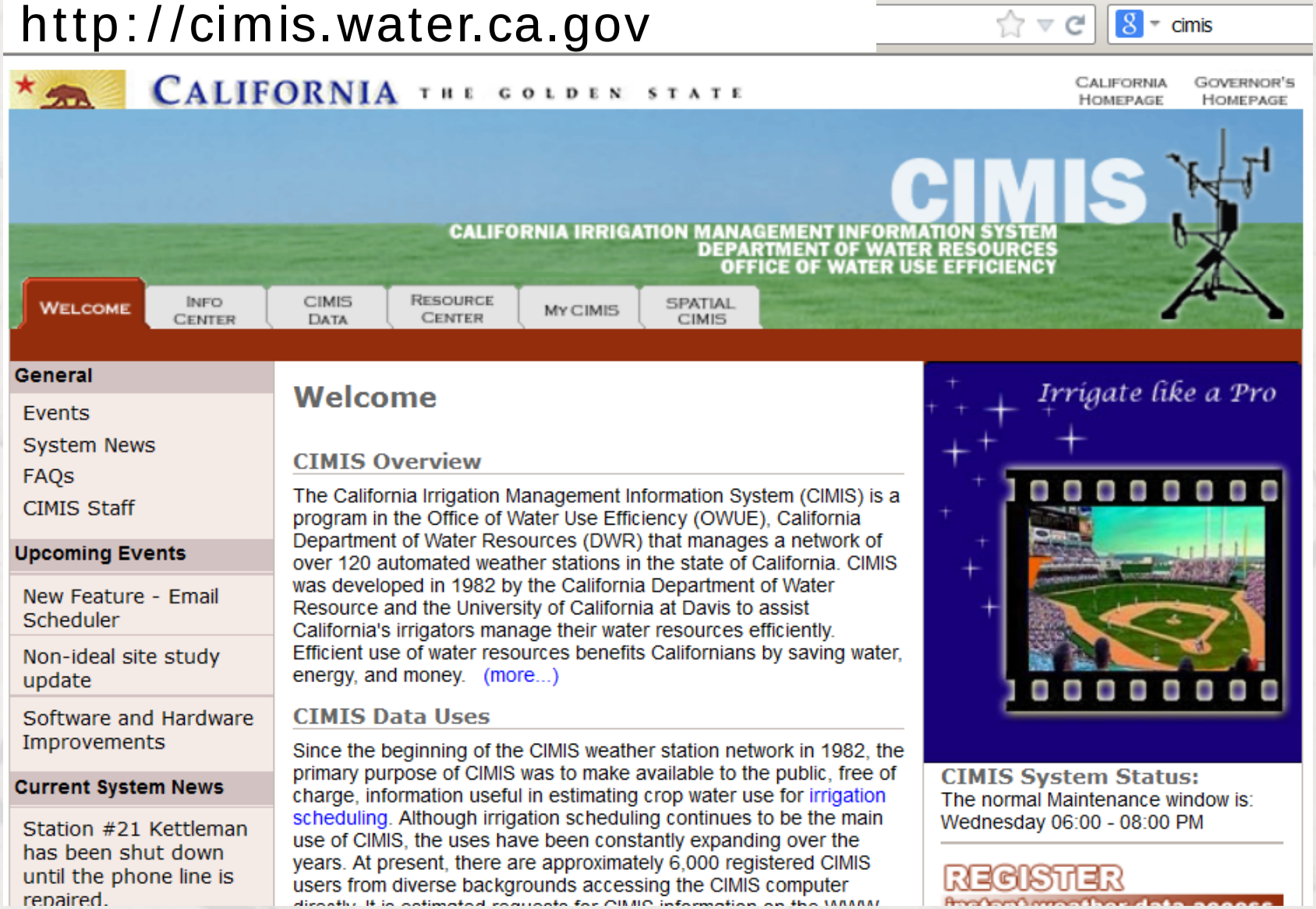
How much water do we evaporate? CIMIS knows!

http://cimis.water.ca.gov



Example: how much water could have been used last week ("reference evapo-transpiration")

Gilroy - San Francisco Bay - Station 211

Date	CIMIS ETo (in)	Precip (in)	Sol Rad (Ly/day)	Avg Vap (mBars)	Max Air Temp (°F)	Min Air Temp (°F)	Avg Air Temp (°F)	Max Rel Hum (%)	Min Rel Hum (%)	Avg Rel Hum (%)	Dew Pt (°F)	Avg wSpd (MPH)	Wnd Run (miles)	Avg Soil Temp (°F)
04/01/2014	0.07	0.74	274	9.3	58.3	41.8	47.4	96	58	84	42.7	4.6	109.9	56.0
04/02/2014	0.15	0.01	529	9.3	63.7	40.2	50.7	99	50	73	42.6	4.2	102.5	56.4
04/03/2014	0.16	0.00	532	8.9	64.4	37.6	51.3	97	44	69	41.6	3.9	93.7	56.7
04/04/2014	0.05	0.24	227	10.5	58.7	43.0	49.8	95	69	86	45.8	3.4	81.9	56.9
04/05/2014	0.19	0.00	546	10.4	68.6	45.5	55.4	95	39	69	45.6	6.9	167.2	57.3
04/06/2014	0.18	0.00	567	11.4	78.5	41.0	59.4	96	38	66	48.0	3.8	90.7	57.9
Tots/Avgs	0.80	0.99	446	10.0	65.4	41.5	52.3	96	50	75	44.4	4.5	107.6	56.9

How does my tree compare to turf: WUCOLS

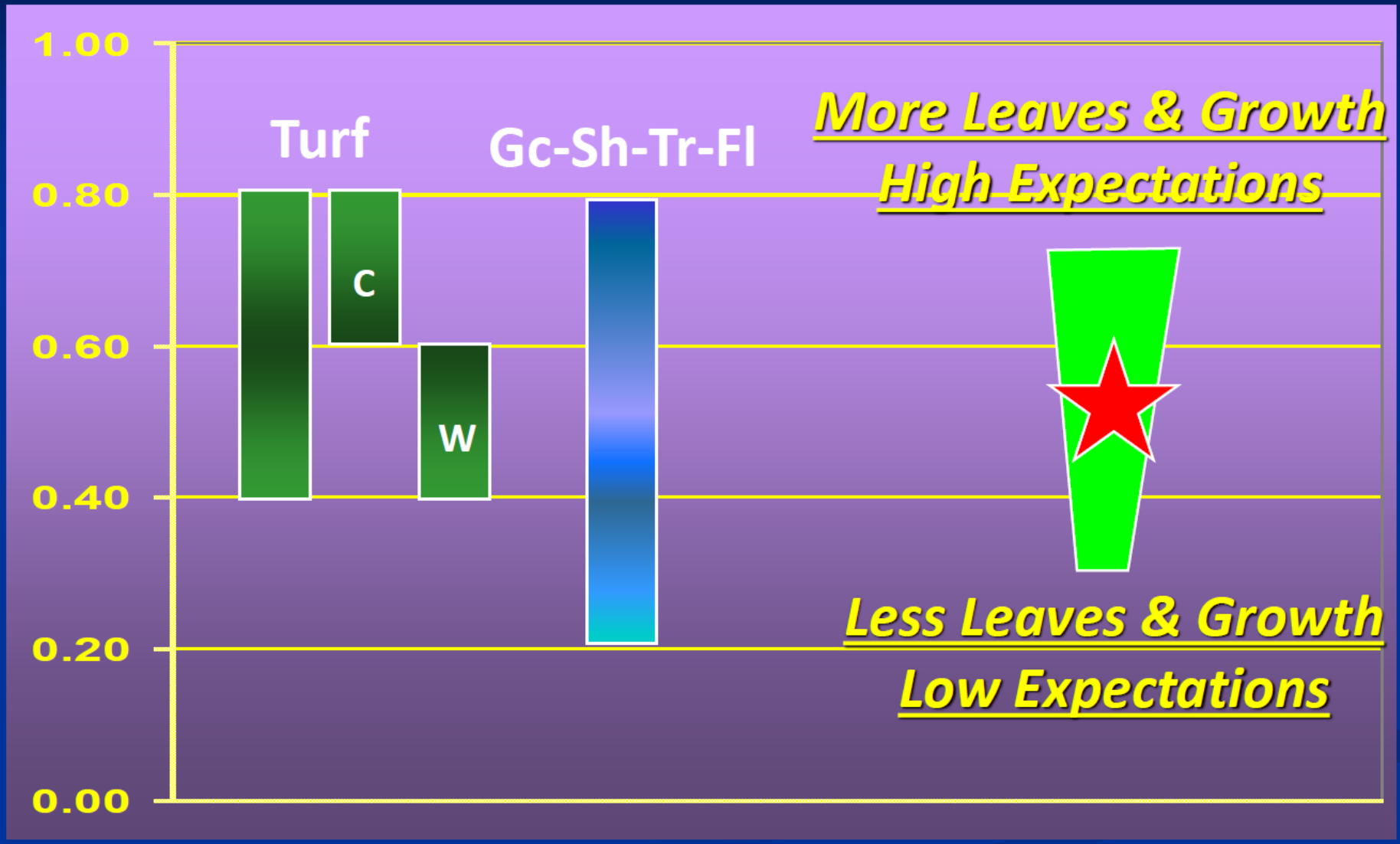
WUCOLS categories

CATEGORIES OF WATER NEEDS

Category	Abbreviation	Percentage of ET_o
High	H	70–90
Moderate	M	40–60
Low	L	10–30
Very Low	VL	< 10

Fig. 2. Five-finger fern was assigned to the "high" water needs category in four regions.

Using & Adjusting PF & Kc Values



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University of California Cooperative Extension

Climate-Based Water Budgets
Adjustment of ETo

Basic Water Budget or Water Requirement

Gallons = ETo × AF × LA × 0.62

gallons = inches × % × sq. ft. × conversion

- ETo = reference evapotranspiration; climate impact
- AF = ETo adjustment factor
- LA = sq. ft. landscape area
- 0.62 converts inches per sq. ft. to gallons [gal. ÷ (in. x sq. ft.)]

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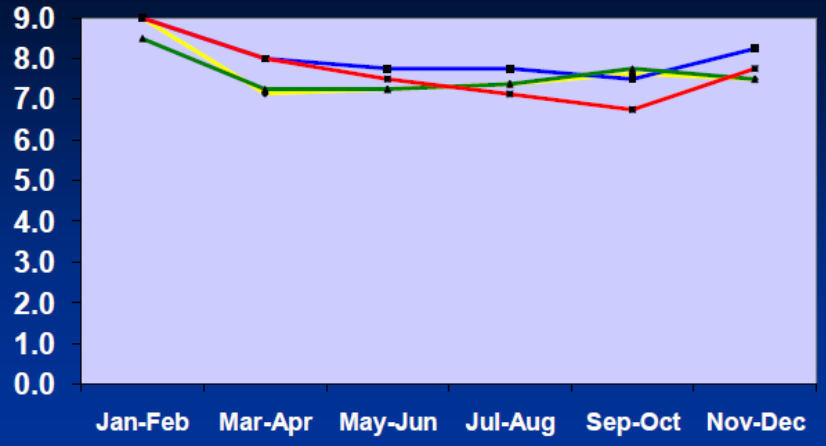
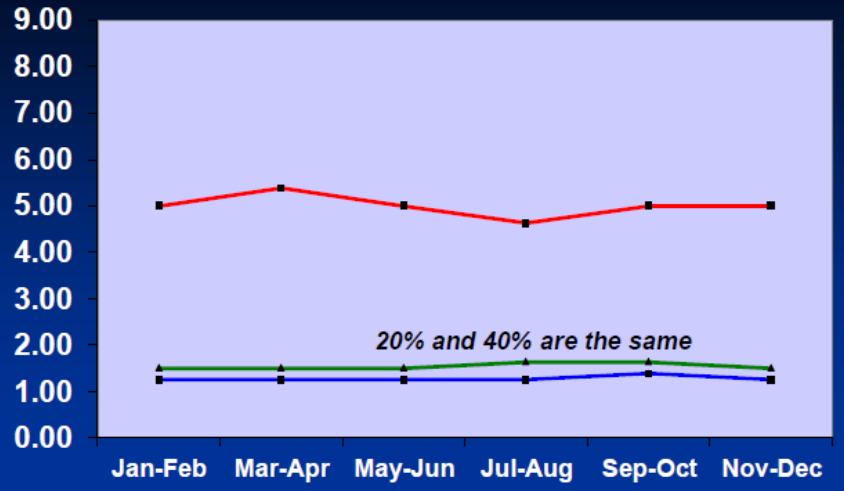
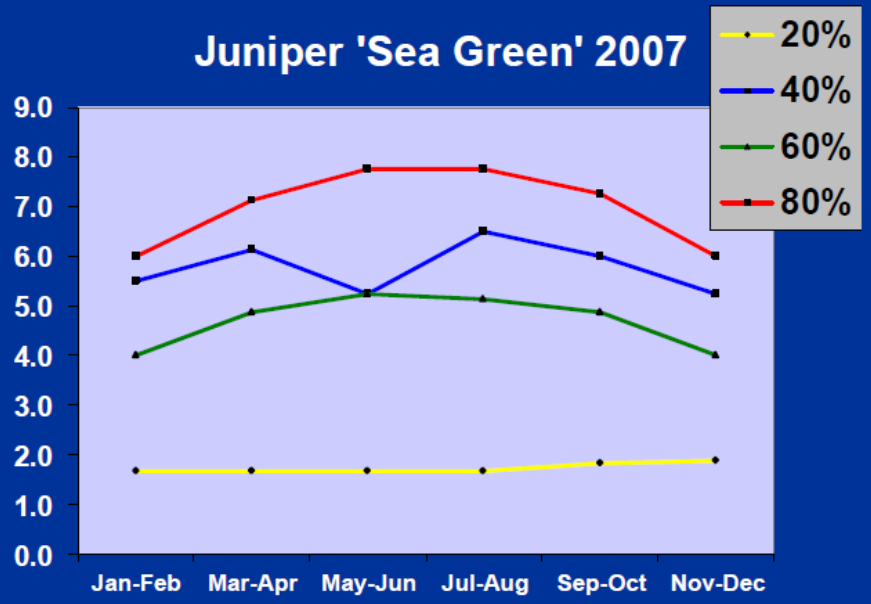
Cassia (Senna) 2007



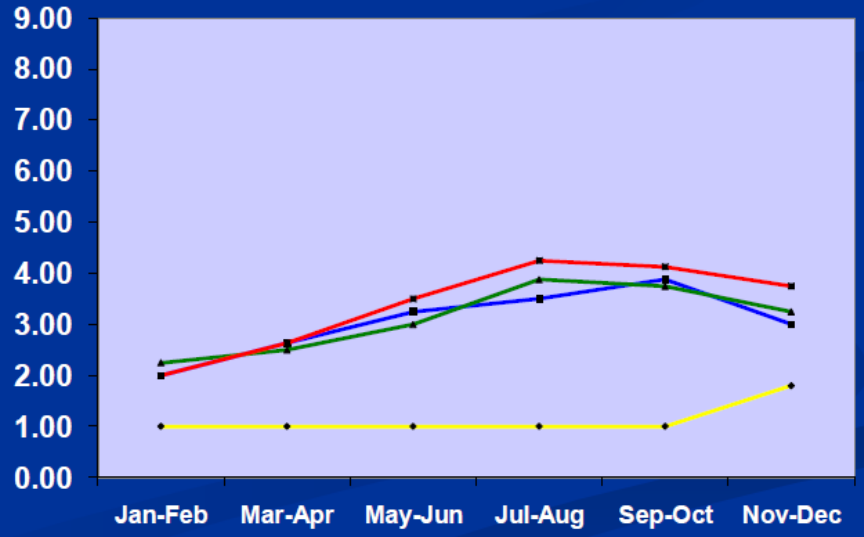
Star Jasmine 2007



Juniper 'Sea Green' 2007



Lantana 2007



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PRINT

Easy Calculators for Estimating Landscape Water Needs

Getting Estimates of Landscape Water Needs

The following pages contain calculators that generate water need estimates for different types of lawns/turf and landscape plants. The calculators are based on field research findings and offer estimated amounts of water particular types of plants need in order to provide acceptable landscape performance.

Use the calculator results as starting points for the amount of water a
Monitor plant performance for a few weeks. If plants appear to be stre
increase the water amount; if plants appear to be over-watered or if t
greater water conservation is desired, then decrease the water amoun
gradually in increments of 10% or less.

Separate calculators deal with different types of plant materials and se
for:

- lawns/turfgrasses.
- mass plantings of non-turf perennial groundcovers.
- beds or mass plantings of annual and perennial flower and similar
- individual trees or shrubs.
- groupings of trees or shrubs.

(It is assumed the plants are established in the landsca

To use these irrigation estimators, you simply need to determine the ty
then enter the size of plant or planted area and the daily reference ev
your location. Follow the link in the estimator instructions to obtain rel
uncertain what they are. Enter a historic average daily ETo or anticipa
of the period if you are using the estimator to predict water needs for
period. For the most accurate irrigation need estimates, enter a currer
value that represents the calendar period of interest. Historic and real-
locations can be found at the CIMIS web site.

Irrigation Calculators
(may not work with Excel 2008 on Macir

Lawn/Turfgrass Irrigation Calculator

Landscape Irrigation Estimator-mass planting or beds of annual & perer

Landscape Irrigation Estimator - non-turf perennial groundcovers

Landscape Irrigation Estimator-individual trees & shrubs

Landscape Irrigation Estimator-groupings & mass plantings of trees and

Landscape Irrigation Estimator

Water needed by plantings of *non-turf perennial groundcovers*

Step 1:
Double click the blue box and input the area of the planting in square feet, then press "Enter". The measurement should be based on the rough dimensions (length x width) of the entire area of the planting. If the planting is irregularly shaped, consider dividing it into approximate rectangular sections and adding together their areas to get a more accurate measure of the total area. There is no need to separate out areas occupied by trees and shrubs mixed in the planting.

Step 2:
Double click the green box. Input the daily reference evapotranspiration (ETo) in inches for the period, then press "Enter".
To find out the ETo for your area of California, go to http://wwwcimis.water.ca.gov/cimis/data.jsp
and use either the real time daily values numbers or an average historical daily value for the time period. If you are projecting a future irrigation schedule, input an average real-time or historical daily ETo based on the most recent 5 to 7 day period or input your best guess. Just be sure to enter a daily ETo number, not a weekly or monthly figure.

Step 3:
The Estimator will provide the estimated plant water need in gallons and inches per day and per week based on the daily ETo value input. Use the number to set your irrigation runtime and schedule based on the performance characteristics of your irrigation system.

Step 4:
Evaluate plant response after a week or so and increase irrigation if the appearance of plants appears to be declining below your expectations as a result of the irrigation amount. If plants meet or exceed your expectations and you want to conserve irrigation water, you can reduce the irrigation amount slightly or extend the interval between irrigation days slightly and re-evaluate plant response. Adjust irrigation amount in increments of no more than 10% and adjust irrigation intervals in one-day increments.

Area of planting in square feet	ET_o average per day	Gallons per day	Gallons per week	Inches per week
100	0.18	5.61	39.27	0.63

ucanr.edu/sites/Wucols

SHARE EMAIL PRINT SITE MAP Enter Search Terms

WUCOLS IV

Water Use Classification of Landscape Species

- Home Page
- User Manual
- Plant Search Instructions
- Plant Search Database
- Download WUCOLS IV Plant List
- Download WUCOLS IV User Manual
- Water Requirements for Turfgrasses
- Partners
- Acknowledgements

Home Page

GETTING STARTED

If you are using the WUCOLS list for the first time, it is essential that you read the *User Manual*. The manual contains very important information regarding the evaluation process, categories of water needs, plant types, and climatic regions. It is necessary to know this information to use WUCOLS evaluations and the plant search tool appropriately. To access the *User Manual*, click on the tab (on left) and view specific topics.

Water conservation is an essential consideration in the design and management of California landscapes. Effective strategies that increase water use efficiency must be identified and implemented. One key strategy to increase efficiency is matching water supply to plant needs. By supplying only the amount of water needed to maintain landscape health and appearance, unnecessary applications that exceed plant needs can be avoided. Doing so, however, requires some knowledge of plant water needs.

WUCOLS IV provides an assessment of irrigation water needs for over 3,500 taxa. Photo by Ellen Zagory.

WUCOLS IV provides evaluations of the irrigation water needs for over 3,500 taxa (taxonomic plant groups) used in California landscapes. It is based on the observations and extensive field experience of thirty-six landscape horticulturists (see the section "Regional Committees") and provides guidance in the selection and care of landscape plants relative to their water needs.

Project Background

The WUCOLS project was initiated and funded by the Water Use Efficiency Office of the California Department of Water Resources (DWR). Work was directed by the University of California Cooperative Extension, San Francisco and San Mateo County office. The first edition of the guide was completed in 1992. A second edition was published in 1994, and a third edition in 1999. In each new edition, additional species were evaluated and included.

Current Update: The 4th Edition (2014)


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University of California
Agriculture and Natural Resources
Cooperative Extension
ilacan@ucanr.edu
510 684 4323