HOW TO MANAGE WATER EFFICIENTLY AND SAVE MONEY

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AGENDA

- FUNDAMENTAL GOAL OF IRRIGATION
  - HOW MUCH and HOW OFTEN?
- HOW TO MONITOR YOUR EFFICIENCY
- WATER SAVING TIPS(4 AREAS)
- DROUGHT PLAN
- REVIEW

HOW MUCH?

- BASED ON THE EVAPOTRANSPIRATION MODEL OR

ET

WHAT IS ET?

- THE LOSS OF WATER TO THE ATMOSPHERE FROM
  - THE SOIL(EVAPORATION)
  - THE PLANT(TRANSPIRATION)

HENCE, ***EVAPOTRANSPIRATION***

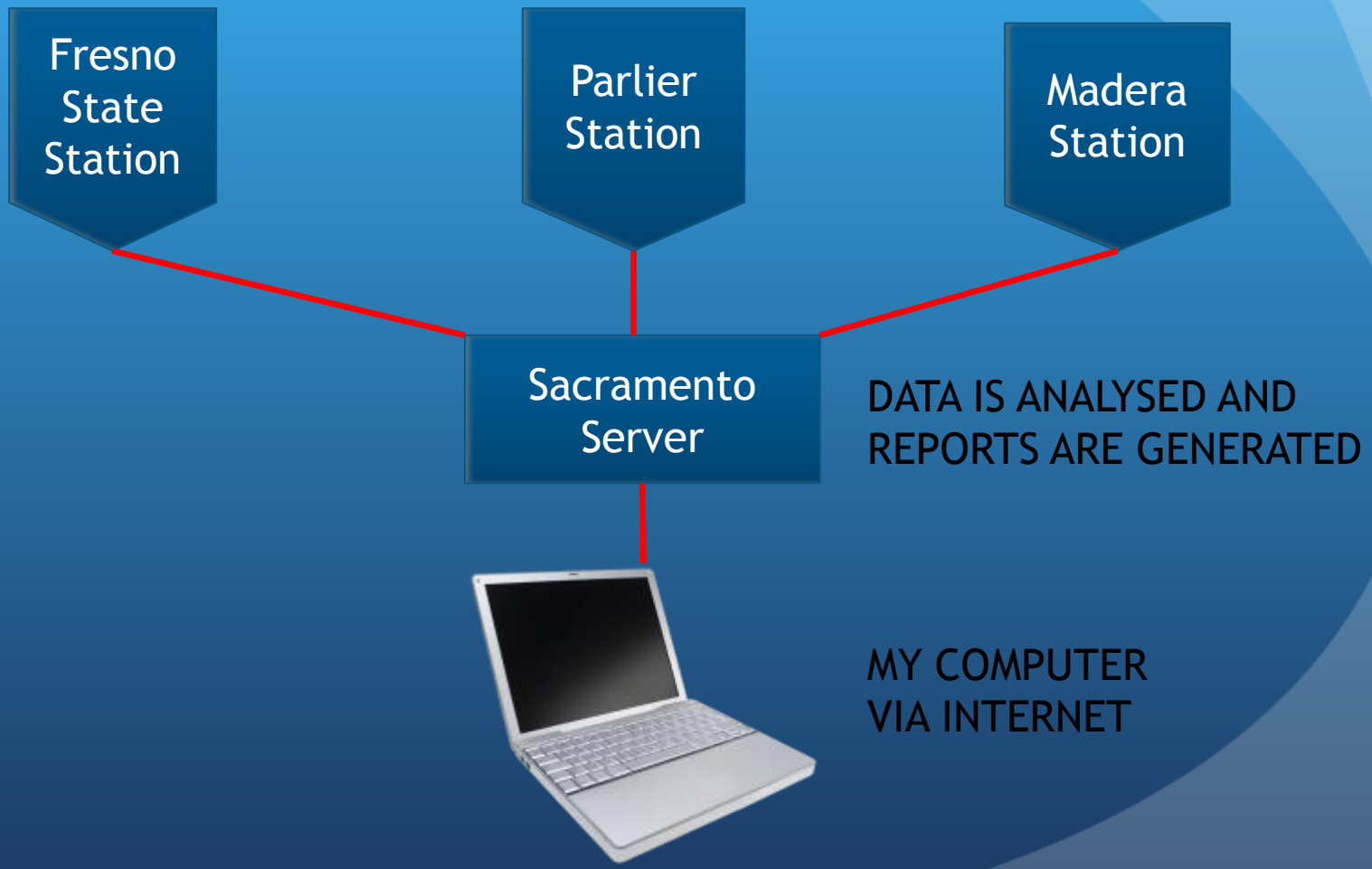
CIMIS –CALIFORNIA IRRIGATION MANAGEMENT INFORMATION SYSTEM

- JOINT PROJECT BETWEEN UC DAVIS AND STATE DEPARTMENT OF WATER RESOURCES
- WEATHER STATIONS THROUGHOUT CALIFORNIA THAT MONITOR ET FOR DIFFERENT GEOGRAPHIC AREAS
- INFORMATION AVAILABLE OVER INTERNET

WHAT IS REFERENCE ET?

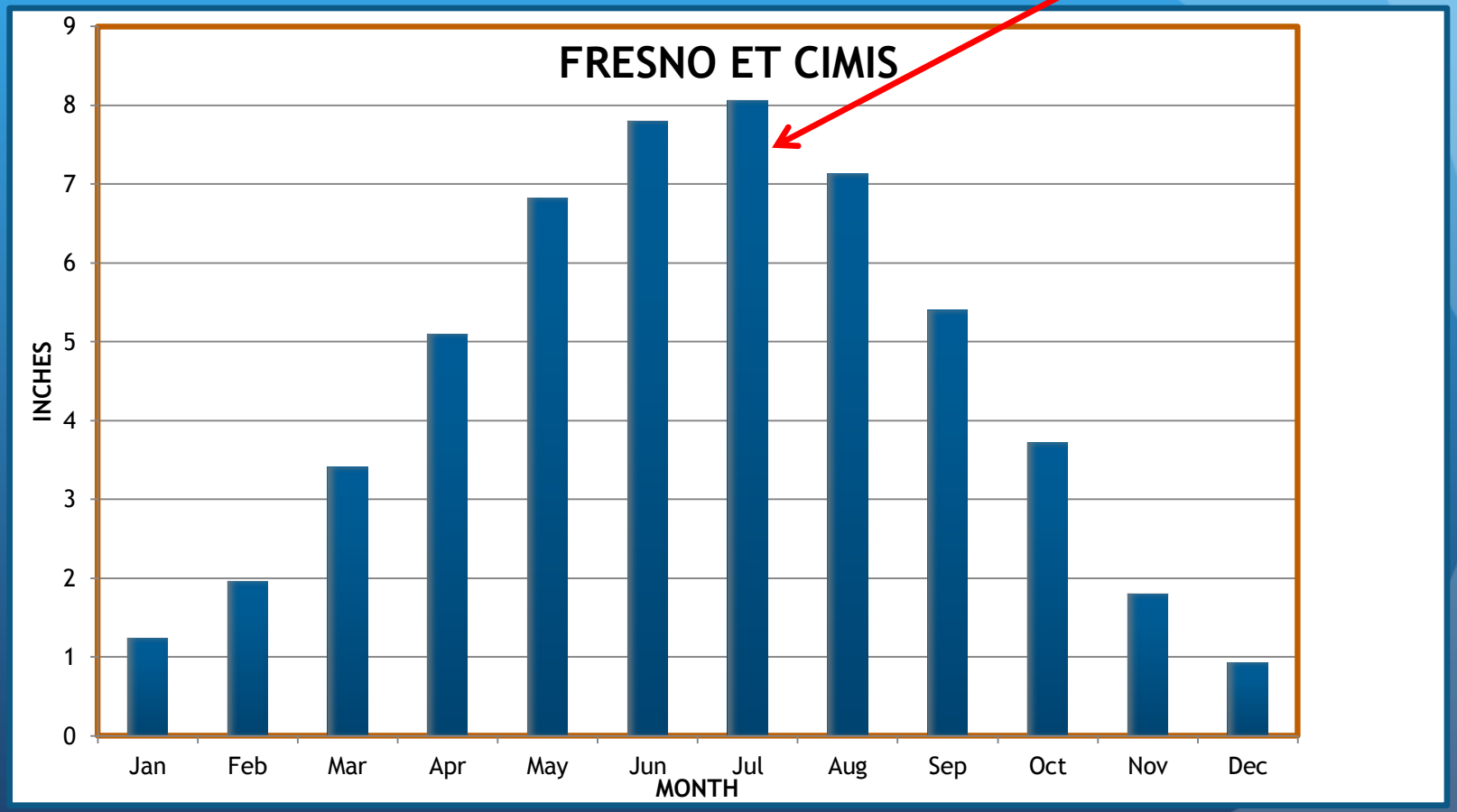
4 IN STAND OF COOL SEASON GRASS ACTIVELY GROWING

MY CIMIS REPORTS



HISTORIC EVAPOTRANSPIRATION CURVE

2 INCHES PER WEEK IN JULY



Evapotranspiration Equation

$$ET_o = \frac{\Delta (R_n - G)}{\lambda[\Delta + \gamma(1 + C_d u_2)]} + \frac{\gamma \frac{37}{T_a + 273.16} u_2 (e_s - e_a)}{\Delta + \gamma(1 + C_d u_2)}$$

HOW DO WE USE ET?
SEASON ADJUST FEATURE

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1.24	1.96	3.41	5.1	6.82	7.8	8.06	7.13	5.4	3.72	1.8	.93
20%	20%	40%	60%	80%	100%	100%	90%	70%	50%	20%	20%

ALL PERCENTAGES ARE CALCULATED BASED ON JULY
EACH MONTH ADJUST YOUR TIMER BASED ON THE ET CURVE

PROCEDURE

- CALCULATE JULY RUN TIMES
- INPUT THESE RUN TIMES INTO YOUR TIMER
- USE THE EVAPOTRANSPIRATION CURVE TO ADJUST RUN TIMES THROUGHOUT THE YEAR BY USING THE SEASON ADJUST FEATURE ON YOUR TIMER

CALCULATE JULY RUN TIME

1. ESTIMATE WATER REQUIRED FOR ZONE(JULY ET)
2. ESTIMATE WATER TO BE APPLIED BY SPRINKLERS(APPLICATION RATE)
3. CALCULATE RUN TIME/WEEK
4. THEN CALCULATE THE RUN TIME/DAY

HOW TO ESTIMATE JULY ET FOR EACH ZONE

- APPLY A FACTOR FOR DIFFERENT ZONES BASED ON PLANT MATERIAL
- MULTIPLY THE FACTOR TIMES REFERENCE ET
- $ET_C = ET_O * K_C$

4 MAIN CATEGORIES OF WATER NEED

- TURFGRASS
  - K_C = 80% TALL FESCUE
  - K_C = 60% BERMUDA
- TREE/SHRUB/GROUNDCOVER/VINE = 50-60%
- LOW EXPECTATION/DESERT ADAPTED = 30-40%
- ANNUAL-PERENNIAL FLOWERS/FOLIAGE = 70-80%

PER SLIDE SYSTEM – DENNIS PITTENGER UC URBAN HORTICULTURE

EXAMPLES FOR JULY ET

- $ET_C = ET_O$ X FACTOR

EXAMPLES:

-ET(TALL FESCUE LAWN) =

2 INCHES/WEEK X .8 = 1.6 IN PER WEEK

-ET(LOW WATER USE)

2 INCHES/WEEK X .3 = .6 IN PER WEEK

HOW DO WE ESTMATE APPLICATION RATE?

- THE CAN TEST – THE BEST WAY TO MEASURE
- BUT YOU CAN ESTIMATE – MANY MANUFACTURERS ESTIMATE FOR YOU
  - ROTATORS = .45-.50 IN./HR.
  - STANDARD SPRAYS = 1.7 IN/HR.
  - OLDER MODELS OVER 2 IN./HR.

CAN TEST

CAN TEST PROCEDURE

- 1. Evenly space six or more straight-sided food containers, such as tuna cans or cat food cans.
- 2. Run your sprinklers for 20 minutes.
- 3. Measure the water in each can with a ruler.
- **Calculations**
  - Average the depths of water by adding up the measurements and dividing by the total number of cans you used.
  - Multiply the average by 3 to estimate how many inches of water your sprinkler system puts out in an hour. Round to the nearest half-inch.

STANDARD SPRAYER
ESTIMATE 1.5 TO 1.7 IN PER HOUR

RUN TIME/WEEK EXAMPLE

- TALL FESCUE LAWN NEEDS 1.6 IN/WEEK IN JULY
- APPLICATION RATE OF SPRINKLERS IS 1.6 IN/HR
- ANSWER: 1 HOUR PER WEEK IN JULY

HOW MUCH TO WATER EACH DAY

- CITY OF FRESNO WATER REGULATIONS(SPRING TO FALL)
  - ODD ADDRESSES – TUESDAY, THURSDAY, SATURDAY
  - EVEN ADDRESSES – WEDNESDAY, FRIDAY, SUNDAY
  - HOUR RESTRICTIONS
    - 12 AM TO 6 AM
    - 7 PM TO MIDNIGHT

- CITY OF FRESNO WATER REGULATIONS(WINTER)
  - ODD ADDRESSES – SATURDAY
  - EVEN ADDRESSES – SUNDAY
  - HOUR RESTRICTIONS
    - NONE

HOW OFTEN

- YOU CAN STILL WATER 11 HOURS PER DAY!
- NIGHTIME WATERING GENERALLY NOT A PROBLEM
- WATER MORNING AND EVENING ON YOUR DAY IF NECESSARY

HOW OFTEN? CONTINUE EXAMPLE

- TALL FESCUE LAWN(60 MINUTES PER WEEK IN JULY)
- DIVIDE BY 3 DAYS = 20 MINS/DAY RUN TIME

FINAL PROCEDURE

- INPUT 20 MIN RUN TIMES FOR 3 DAYS PER WEEK(JULY ET)
- USE SEASON ADJUST THROUGH THE YEAR(SPRING TO FALL)
- TURN OFF SPRINKLERS IN WINTER AND DO MANUAL RUNS IF NEEDED

CHALLENGE QUESTION

- HOW LONG SHOULD YOU RUN YOUR SPRINKLERS IN MARCH FOR THIS FESCUE LAWN?

SEASON ADJUST FEATURE

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ALL PERCENTAGES ARE CALCULATED BASED ON JULY
EACH MONTH ADJUST YOUR TIMER BASED ON THE ET CURVE

ANSWER

- 1 HOUR/WEEK X 40 %(SEASON ADJUST) = 24 MINUTES/WEEK
- 24 MINUTES / 3 DAYS = 8 MINUTES PER DAY

FOR OUR EXAMPLE

- SET TIMER NEXT WEEK
  - 20 MINUTE RUNS
  - 3 TIMES PER WEEK
  - SET SEASON ADJUST AT 40%
- SEASON ADJUST THROUGH THE FALL

WHAT ABOUT DRIP?

- UNIT OF MEASURE: GALLONS PER WEEK
- REFERENCE - LARGE ROSE BUSH
  - 5-7 SQ. FT. CANOPY
  - 5 GALLONS OF WATER PER WEEK IN JULY
- EMITTERS GENERALLY .5, 1.0 OR 2.0 GPH
- FOR JULY A LARGE ROSE
  - WITH TWO 1 GPH EMITTERS
  - 2.5 HOURS/WEEK IN JULY
- SEASON ADJUST THROUGHOUT THE YEAR

HOW TO MONITOR EFFICIENCY

- EFFECTIVE ROOTING ZONE – WHERE PLANTS OBTAIN MOST OF THEIR WATER – UPPER 70%
- THEREFORE, MONITOR THE UPPER 70% OF ROOTING ZONE

HOW DO YOU MONITOR?

- SOIL PROBE – A METAL ROD, LONG HANDLED SCREWDRIVER, STICK OR SHOVEL
- WAIT UNTIL THE MORNING AFTER YOU WATER AND PROBE THE SOIL – NOT PERFECT BUT QUITE ACCURATE
- ADJUST RUN TIMES TO CHANGE DEPTH

EFFECTIVE ROOTING ZONES

- GENERAL GUIDELINES PER THE MG MANUAL
  - LEAFY VEGETABLES, ANNUALS – 6 IN. TO 1 FT.
  - SMALL SHRUBS, COOL SEASON TURF, TOMATOES – 1 TO 2 FT.
  - LARGE SHRUBS, WARM SEASON TURF, TREES – 1.5 TO 5 FT.

ROOTING ZONES OF MAJOR CROPS

PER UNIVERSITY OF CALIFORNIA

Crop	Depth in feet	Crop	Depth in feet
Alfalfa	4 to 6	Grapes	3 to 5
Almonds	2 to 4	Hops	3to 5
Apricots	2 to 4.5	Ladino clover and grass mix	2
Artichokes	2 to 3	Lettuce	1 to 2
Asparagus	6	Melons	3 to 4
Beans (dry)	2	Milo	4
Beans (green)	2	Oats	2-3
Beans (lima)	4	Olives	3-4
Beets (sugar)	3 to 5	Onions	1 to 2
Beets (table)	2 to 3	Pasture grasses (annual)	2
Broccoli	2	Pasture grasses (perennial)	2 to 3
Bush berries	3 to 5	Peas	1 to 2
Cabbage	2	Peaches	2 to 4
Cantaloupes	2 to 4	Pears	3 to 4
Carrots	2 to 3	Prunes	3 to 4
Cauliflower	2	Peppers	2 to 3
Celery	2	Potatoes (Irish)	2 to 3
Chard	3	Potatoes (sweet)	2 to 3
Cherries	2.5 to 4	Pumpkins	3 to 4
Citrus	2 to 4	Radishes	1
Corn (sweet)	3	Spinach	1
Corn (field)	2 to 4	Squash (summer)	1 to 2
Cotton	3.5	Strawberries	1 to 2
Cucumber	2	Sudan grass	3 to 4
Eggplant	2	Tomatoes	2 to 4
Figs	2 to 4	Turnips	1.5 to 2.5
Garlic	1 to 2	Walnut	5 to 7
Grain and flax	2 to 3	Watermelons	2 to 3

LIMITATION TO ET METHOD

- ET METHOD IS BASED ON HISTORIC ET
- EVERY YEAR IS DIFFERENT
- ET METHOD USES AVERAGES – ET CURVES FOR INDIVIDUAL CROPS DO NOT EXACTLY TRACK ET_0
- SO, YOU STILL HAVE TO MONITOR YOUR GARDEN!

WHAT ABOUT SMART TIMERS

- SMART TIMERS AUTOMATICALLY ADJUST RUN TIMES WITH INPUT FROM A WEATHER STATION
- MANY PEOPLE FIND THEM FRUSTRATING TO USE
- INNOVATIVE NEW PRODUCTS THAT USE YOUR SMARTPHONE TO CONTROL YOUR IRRIGATION

SMART CONTROLLERS

SMART TIMERS

- RECOMMENDATIONS
  - READ THE MANUAL THOROUGHLY
  - JULY RUN TIMES MUST BE ACCURATE
  - EXPERIMENT WITH LOCATING YOUR WEATHER STATION

IRRIGATION OF THE FUTURE

- SOIL SENSOR TECHNOLOGY?
- MONITORS ROOT ZONE MOISTURE 24/7
- AG IS WAY AHEAD OF ORNAMENTAL HORTICULTURE
- TOO EXPENSIVE, TOO COMPLICATED NOW

IRRIGATION PART II

- YOU HAVE YOUR BASIC RUN TIMES
- HOW CAN YOU DECREASE RUN TIMES TO IRRIGATE MORE EFFICIENTLY?
- TIPS FOR FOUR AREAS OF YOUR GARDEN
  - LAWNS
  - SHRUBS
  - FRUIT TREES
  - VEGETABLE GARDENS

LAWN RECOMMENDATIONS

LAWNS

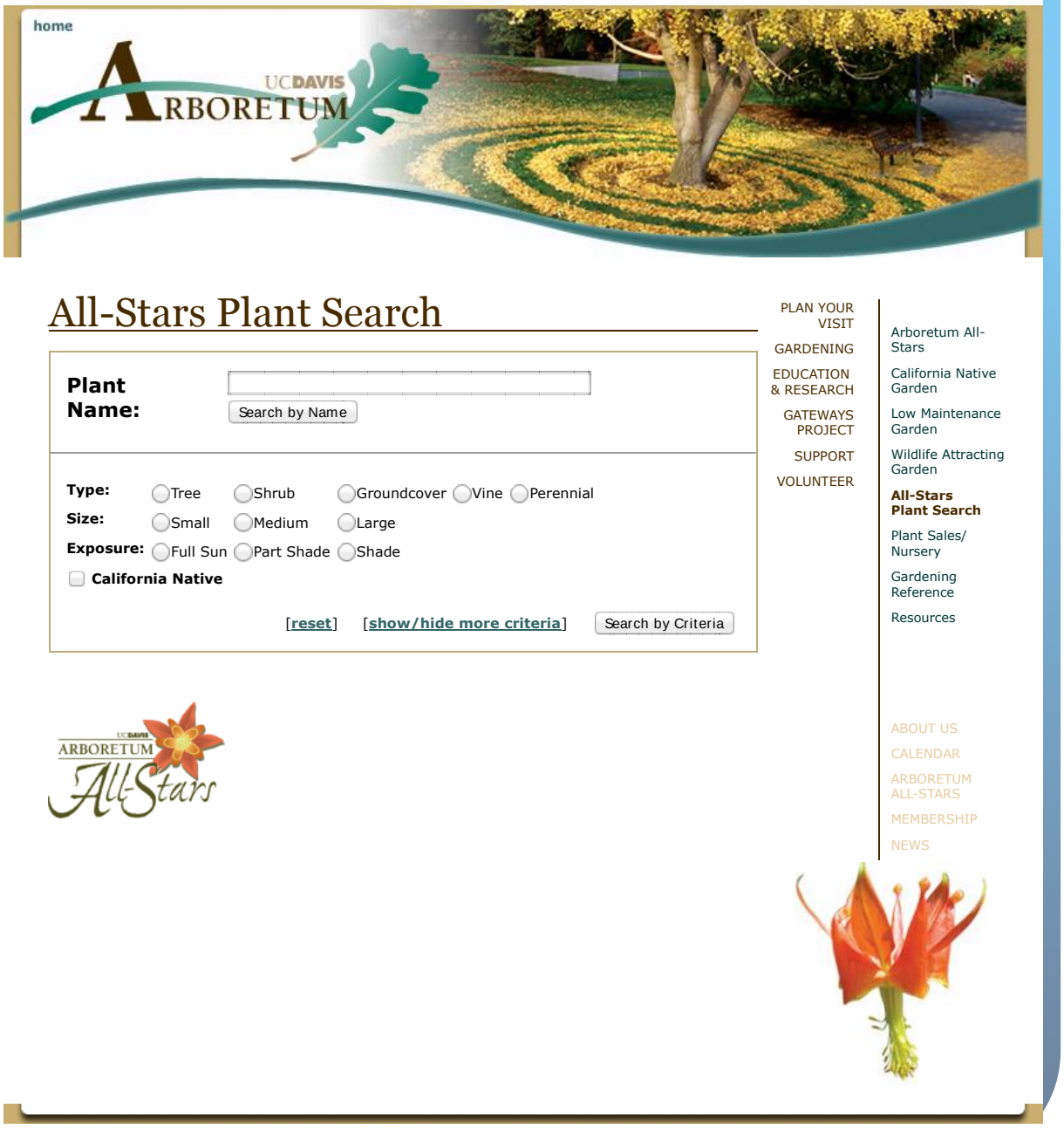
- CHECK YOUR SPRINKLERS MONTHLY
- CONSIDER ROTATOR TECHNOLOGY
- CYCLE AND SOAK
- GRASSCYCLE
- DO NOT OVERFERTILIZE
- LAWNS DON'T WASTE WATER – HOMEOWNERS DO

SHRUBS

SHRUB PLANTINGS

- RIGHT PLANT RIGHT PLACE (GET RID OF WATER HOGS)
  - UC DAVIS ARBORETUM ALL STARS
- NEW PLANTINGS MUST BE IRRIGATED SHALLOW AND FREQUENTLY
- **SLIDE** – NEW UC RESEARCH INDICATES MANY LANDSCAPE PLANTINGS NEED LESS WATER THAN THOUGHT
- MULCH, MULCH, MULCH

PLANT SEARCH ON UC DAVIS ARBORETUM WEB SITE



FRUIT TREES

FRUIT TREES

- *HOW MUCH TO WATER DIFFERENT KINDS OF PLANTS IN CALIFORNIA'S INLAND AREAS*
  - By Larry J. Schwankl and Pamela Geisel UCCE
- IRRIGATE TO THE CANOPY LINE
- USE DRIP
- MULCH, MULCH, MULCH
- KEEP FRUIT TREES SMALL BY BUSH TRAINING
  - *FRUIT TREES: TRAINING AND PRUNING DECIDUOUS TREES* By Ingels, Geisel and Unruh
  - 10 GALLONS PER DAY VS 60 GALLONS PER DAY!
  - PLUS BUSH TRAINED TREES ARE EASIER TO THIN, PRUNE AND HARVEST

HOW TO IRRIGATE TREES

VEGETABLES

WARNING!
VEGETABLES – HEAVY WATER USER

- *HOW MUCH TO WATER DIFFERENT KINDS OF PLANTs IN CALIFORNIA'S INLAND AREAS*
  - By Larry J. Schwankl and Pamela Geisel UCCE
- COMPOST, COMPOST, COMPOST
- DRIP IRRIGATION
- MULCH, MULCH, MULCH – COLORADO STATE SAYS YOU CAN SAVE 50%
- PULL PLANTS AFTER HARVEST AND SHUT OFF WATER
- CROP ROTATION – USE ONLY A THIRD OF YOUR VEG GARDEN
- DO YOU NEED TO GROW SUMMER VEGETABLES?
  - FALL VEGETABLES
  - WINTER VEGETABLES

WELL MULCHED VEGETABLES

CAUTIONS CONCERNING MULCH

- TWO UC STUDIES
- MULCHES MAY BE A FIRE HAZARD
  - TIRE PRODUCT AND PINE STRAW WERE THE MOST FLAMMABLE
  - KEEP MULCH AWAY FROM YOUR STUCTURES
- IF YOU ARE USING OVERHEAD SPRAYERS, WATER MAY GET STUCK IN THE MULCH.
  - USE A COARSE MULCH
  - INCREASE RUN TIMES TO GET THE WATER THROUGH THE MULCH
  - BEST IDEA – USE DRIP UNDERNEATH THE MULCH

DROUGHT RECOMMENDATIONS

- UC DOES NOT RECOMMEND COMPLETELY RENOVATING YOUR GARDEN
- IN A SEVERE DROUGHT MAINTAIN TREES AND LARGE PLANTINGS. LAWN AND ANNUALS CAN BE REPLACED EASILY
- UC RESOURCES
  - *KEEPING LANDSCAPE PLANTINGS ALIVE UNDER DROUGHT OR WATER RESTRICTIONS* BY HARTIN AND FABER
  - *WATER CONSERVATION TIPS FOR THE HOME LAWN AND GARDEN* BY GEISEL AND UNRUH

SUMMARY

- USE SEASON ADJUST FEATURE
- IRRIGATE UP AND DOWN THE EVAPOTRANSPIRATION CURVE
- CHECK YOUR SOIL WITH A PROBE
- CYCLE AND SOAK YOUR LAWN
- UC DAVIS ARBORETUM ALL STARS
- KEEP FRUIT TREES SMALL
- MULCH YOUR VEGETABLES
- PLAN NOW FOR A MAJOR DROUGHT
- AND ALWAYS, MONITOR YOUR GARDEN OFTEN