



Cotton Water Requirements in Humid Areas

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Evapotranspiration

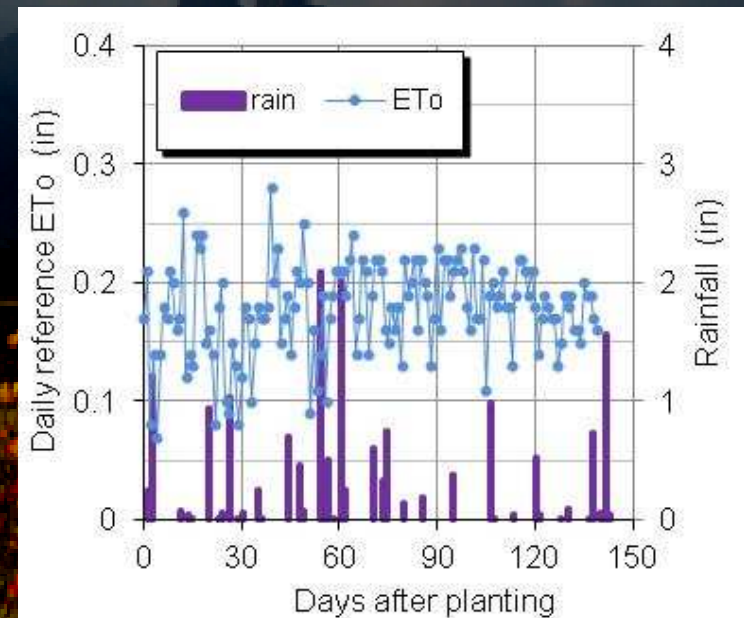
- cotton uses water throughout its lifecycle
 - evaporation
 - from the soil surface
 - significant during early season when plants are small
 - transpiration
 - as it grows and transpires
 - minimal early, increases as plants grow
- evapotranspiration (ET)
 - combined process
 - quantifies total water used by cropping system

Environmental demand

- evapotranspiration a result of atmosphere, environmental demand
- can vary greatly day to day
 - hot, dry and windy
 - air is drier, mixes
 - more solar energy
 - higher ET
 - cool, cloudy, and calm
 - higher humidity
 - lower solar energy
 - lower ET

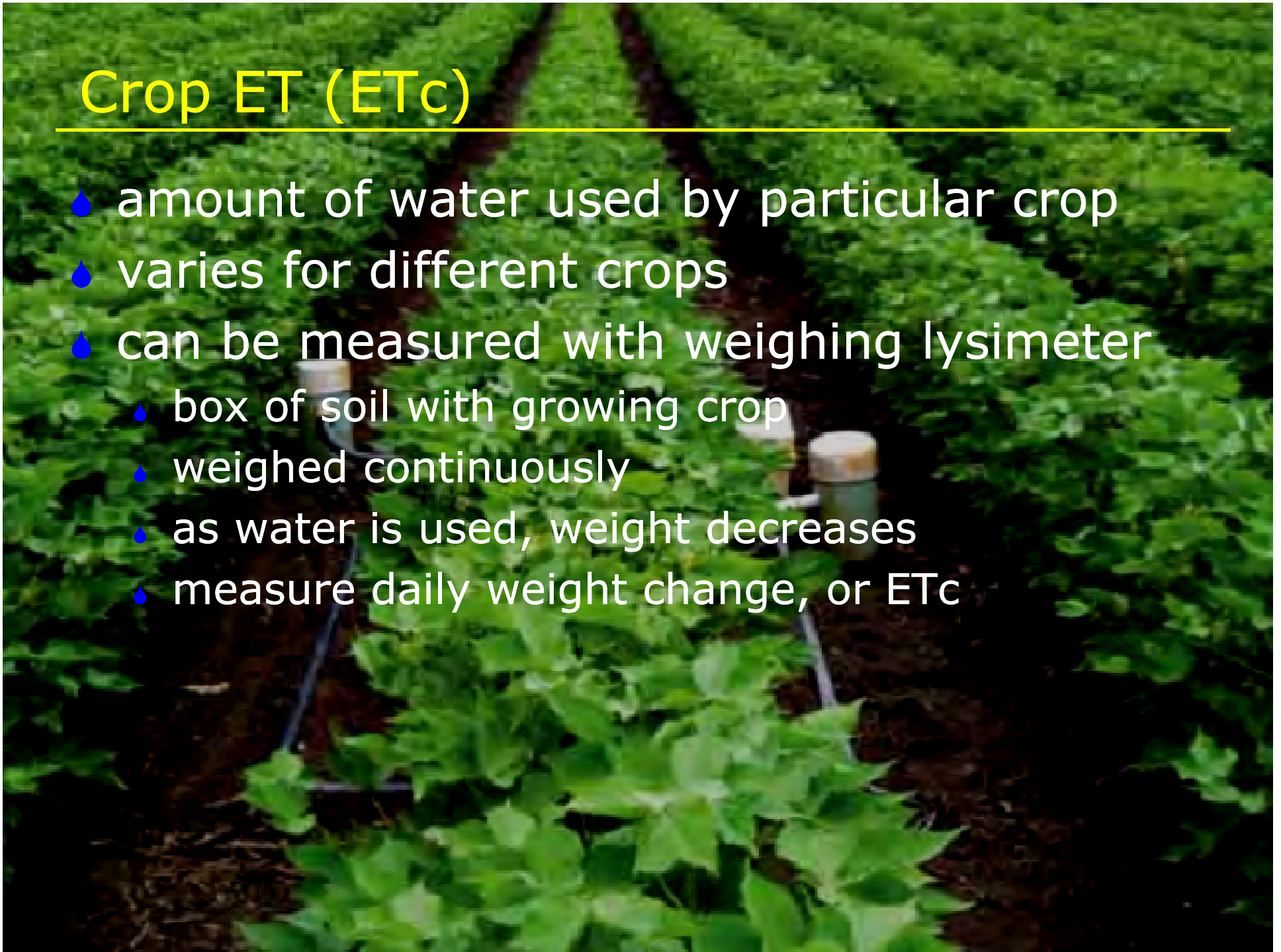
Reference ET (ET_o)

- a measure of environmental demand
- created to standardize ET estimates, methods
- describes ET from well-watered grass surface
- function of weather variables
 - solar radiation
 - air temperature
 - humidity
 - wind
- varies on daily basis
- varies throughout season



Crop ET (ET_c)

- amount of water used by particular crop
- varies for different crops
- can be measured with weighing lysimeter
 - box of soil with growing crop
 - weighed continuously
 - as water is used, weight decreases
 - measure daily weight change, or ET_c

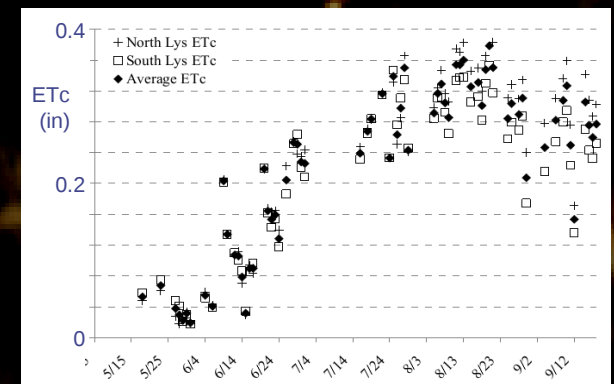
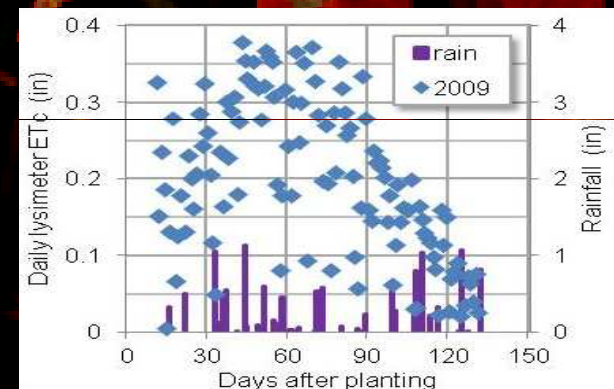
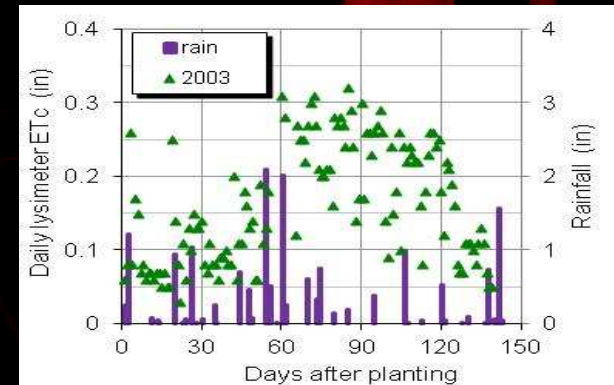


Crop ETc

lysimeters in southeast

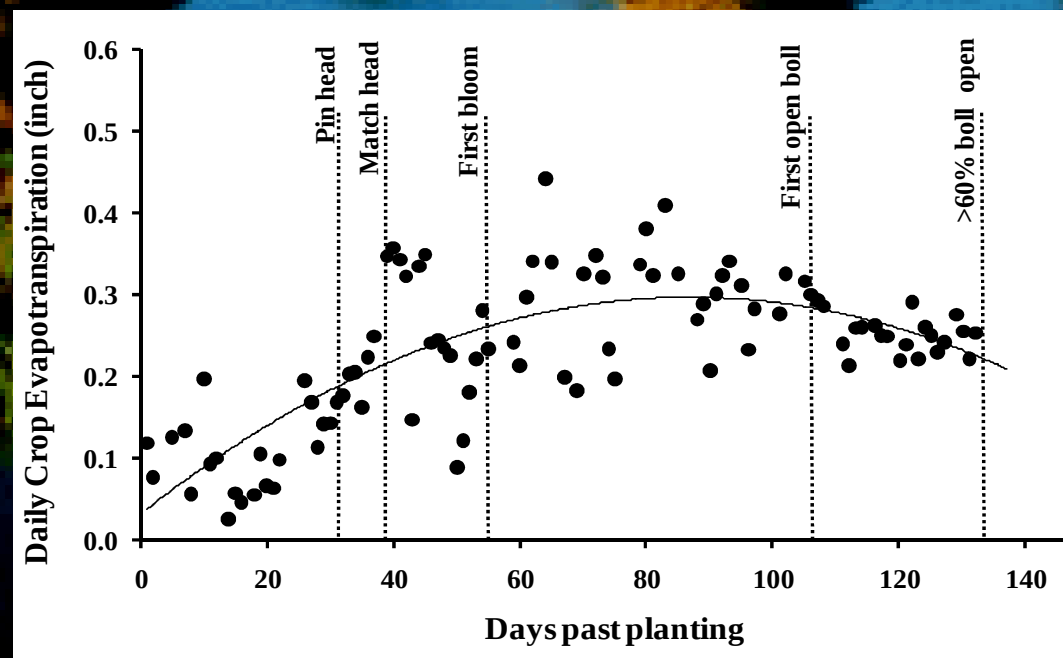
- Stoneville, MS (USDA)
- Blackwell, SC (Clemson)
- St. Joseph, LA (LSU)

	peak ETc	avg peak ETc
MS	0.32 in/day	0.28 in/day
SC	0.38	0.35
LA	0.38	0.33



Water use at different growth stages

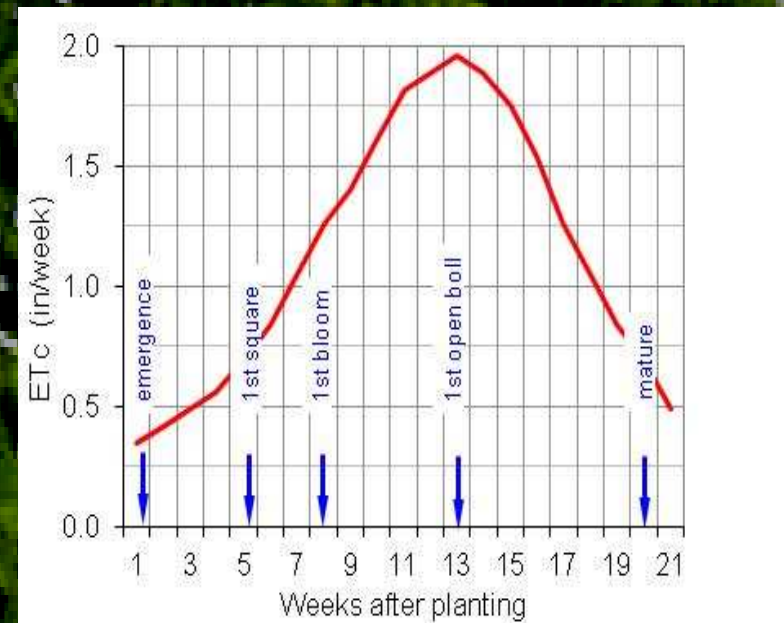
- evaporation early in the season
- transpiration increases
- peaks around 1st open boll
- steadily declines



Weekly water needs

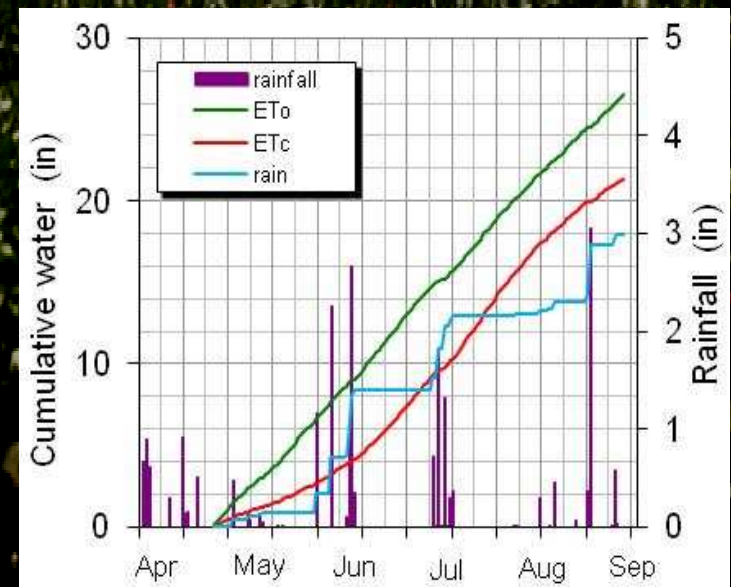
- crop ETc occurs daily
- accumulates to weekly crop water use
- becomes weekly crop water requirements
 - available soil-water reserves
 - from rainfall
 - or provided by irrigation

early season 0.5 in/wk
developing 1-1.5 in/wk
peak period >2 in/wk



Seasonal total water needs

- ETo (reference ET)
 - environmental demand
- ETc (crop ET)
 - depends on particular crop
 - cotton: 20 - 25 in/yr
- rainfall
 - sufficient during season?
- irrigation
 - may be needed

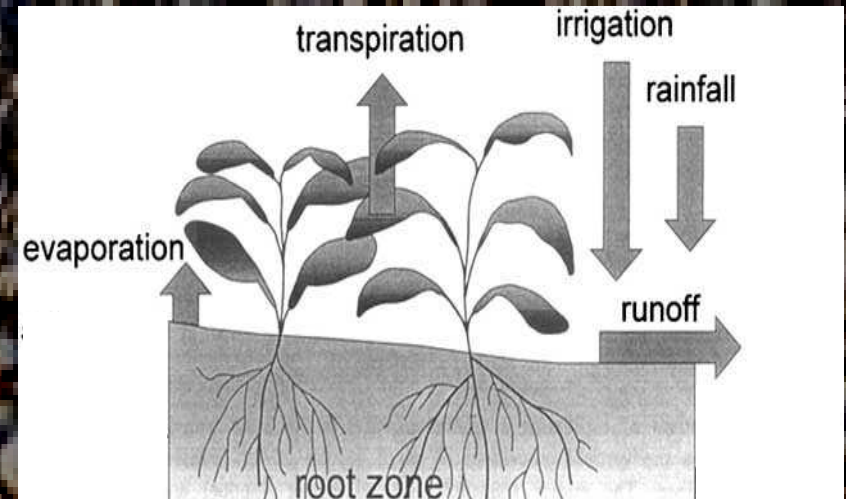


Water use/resources

- 💧 want to use, manage water resources
 - 💧 ensure crop has adequate amount
 - 💧 available at appropriate times
 - 💧 use water efficiently
- 💧 need to keep track of water resources
 - 💧 amount used by cropping system
 - 💧 rainfall
 - 💧 irrigation
- 💧 ensure availability for crop

Water balance

- keep track of water available in root zone
- moves in and out constantly
 - main components
 - outgoing water
 - evaporation
 - transpiration
 - runoff
 - incoming water
 - rainfall
 - irrigation
- have idea if sufficient for crop needs



Accounting of water resources

- use water balance model
 - checkbook method
 - keep track of withdrawals, deposits
 - know your balance (or total expenditures)
 - deposits
 - rainfall
 - irrigation
 - withdrawals
 - evapotranspiration

Water balance model

- components can be estimated, measured

- $$SWD_i = SWD_{i-1} + I + Pe - ET_c$$

SWD_i = today's soil-water deficit

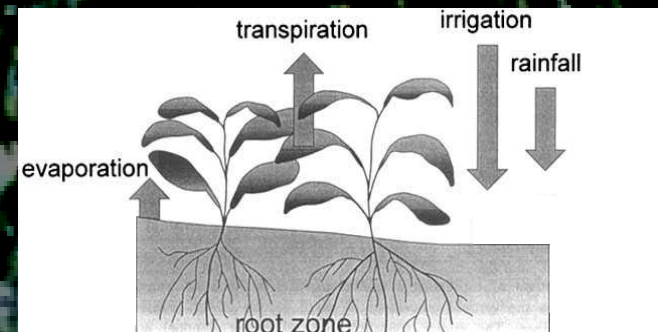
SWD_{i-1} = yesterday's deficit

I = irrigation water applied

Pe = effective precipitation

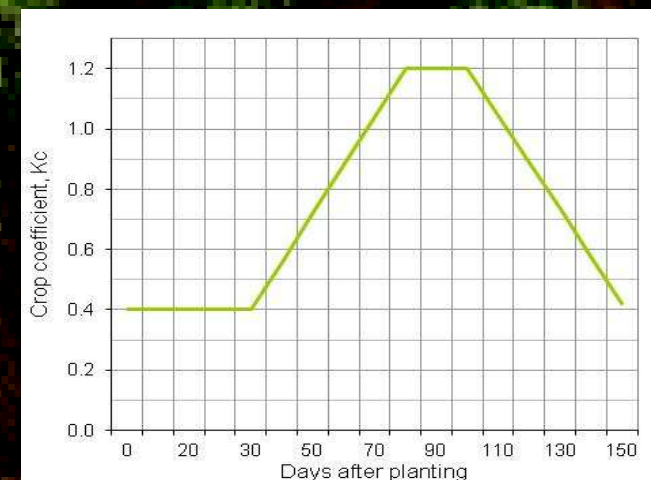
ET_c = crop evapotranspiration

- irrigate when critical SWD level is reached



ETc estimation

- function of weather and crop
- weather
 - environmental demand, ETo
- crop
 - crop coefficient, Kc
 - crop specific
 - relative to reference ET
 - different growth stages
 - $ET_c = K_c * ETo$



Irrigation scheduling programs

- many scheduling options available
 - Mississippi, Tennessee
 - internet-based tools
 - Arkansas
 - Arkansas Irrigation Scheduler
 - stand-alone computer program
 - uses checkbook/water-balance method
 - requires minimal user input
 - estimates ETc
 - tracks daily soil-water depletion
 - user decides when to irrigate

Irrigation scheduling

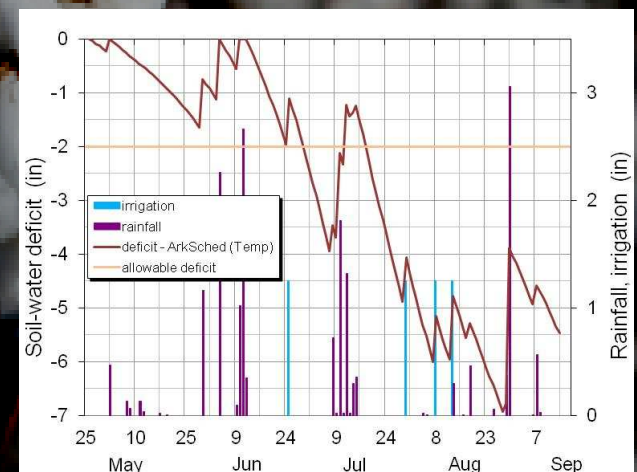
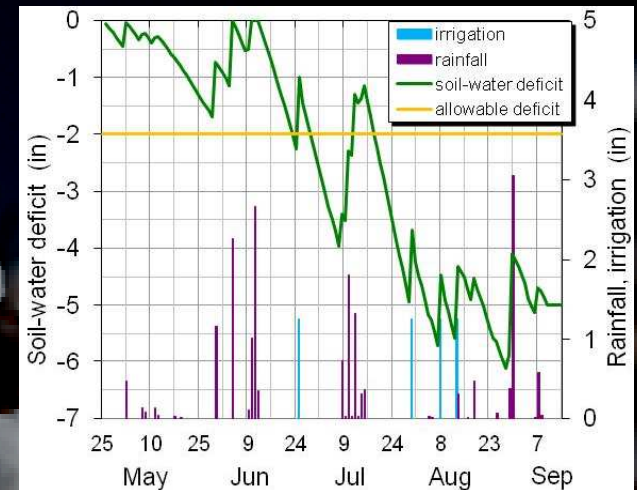
💧 scheduling model output

💧 spreadsheet model in Excel

- weather data, estimate ET_o
- Kc function to calculate ET_c
- estimate effective precipitation
- update daily SWD

💧 Arkansas Irrigation Scheduler

- air temperature, estimate ET_o
- precipitation
- daily SWD, predict few days
- guidance on allowable limit



Soil-moisture sensors

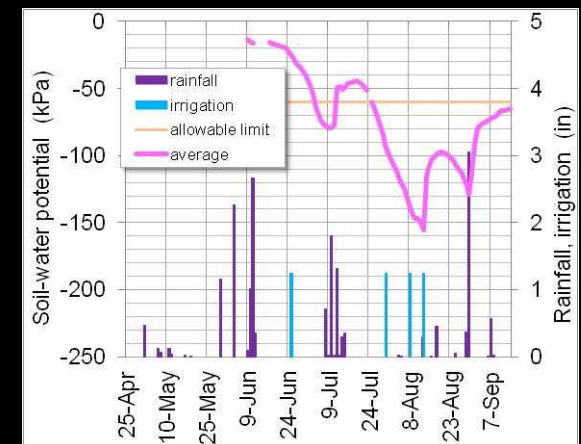
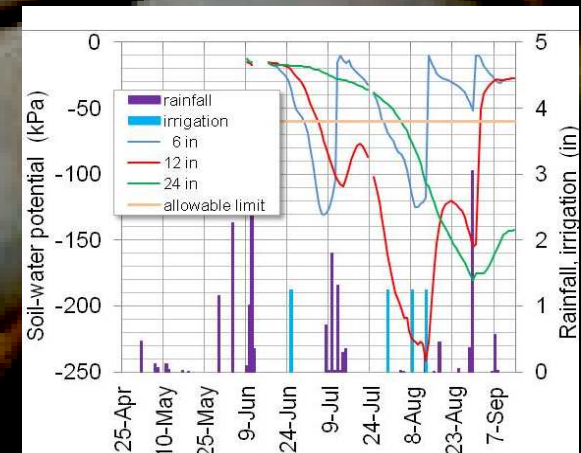
- another scheduling tool
- install sensors in root zone in the field
- sensors monitor water status directly
 - no theoretical models, estimates, data input
 - respond to actual field conditions
 - takes labor to install and maintain
 - expense involved
- usually used for real-time scheduling

Passive sensor-based monitoring

- used for post-season analysis
 - install sensors, monitoring equipment
 - go about normal production operations
 - passively collect data throughout season
- after season ends, analyze data
 - crop water use
 - irrigation performance

Soil-moisture monitoring

- sensors installed in irrigated plot
 - Watermark matric-potential sensors
 - 3 depths
 - 6, 12, 24 in below surface
 - automated measurements
 - data collected every hour
- average of hourly readings
 - similar to water balance model



Cotton water requirements

- crop needs adequate water
 - responds to environmental demand
 - water use changes throughout season
- need to be aware of needs, resources
 - crop water needs
 - available soil-water resources
- monitoring and scheduling tools
 - track water resources
 - predict irrigation requirements

Further information

- Cotton Irrigation Management for Humid Regions
 - Section 4: Cotton water requirements
 - Section 7: Irrigation scheduling tools

