

Water Management

Water quantity

Water quality

Why do plants need water?

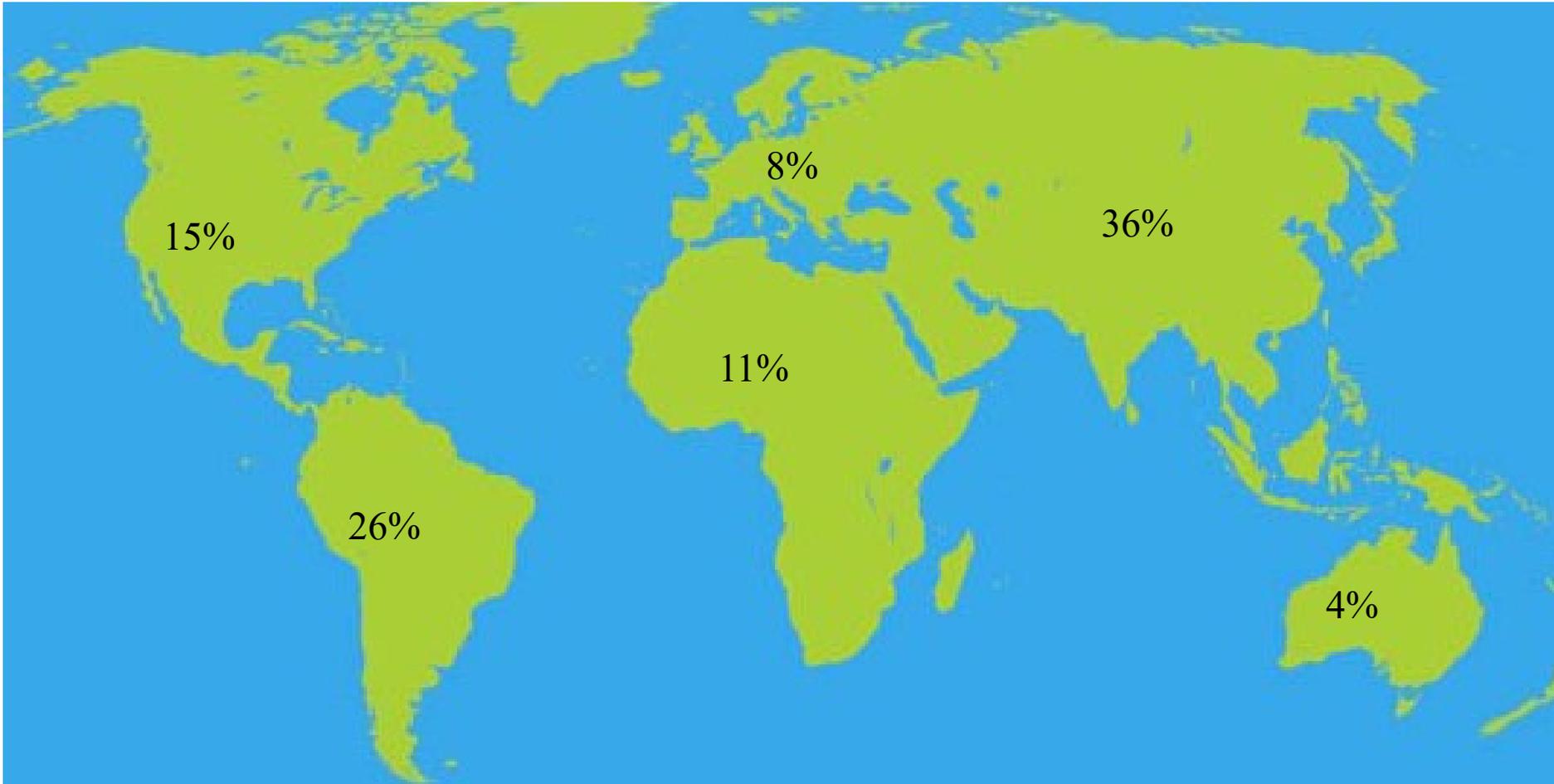
- Transpiration
- Photosynthesis
- Growth/germination
- Medium of transport



Distribution of fresh water among different continents

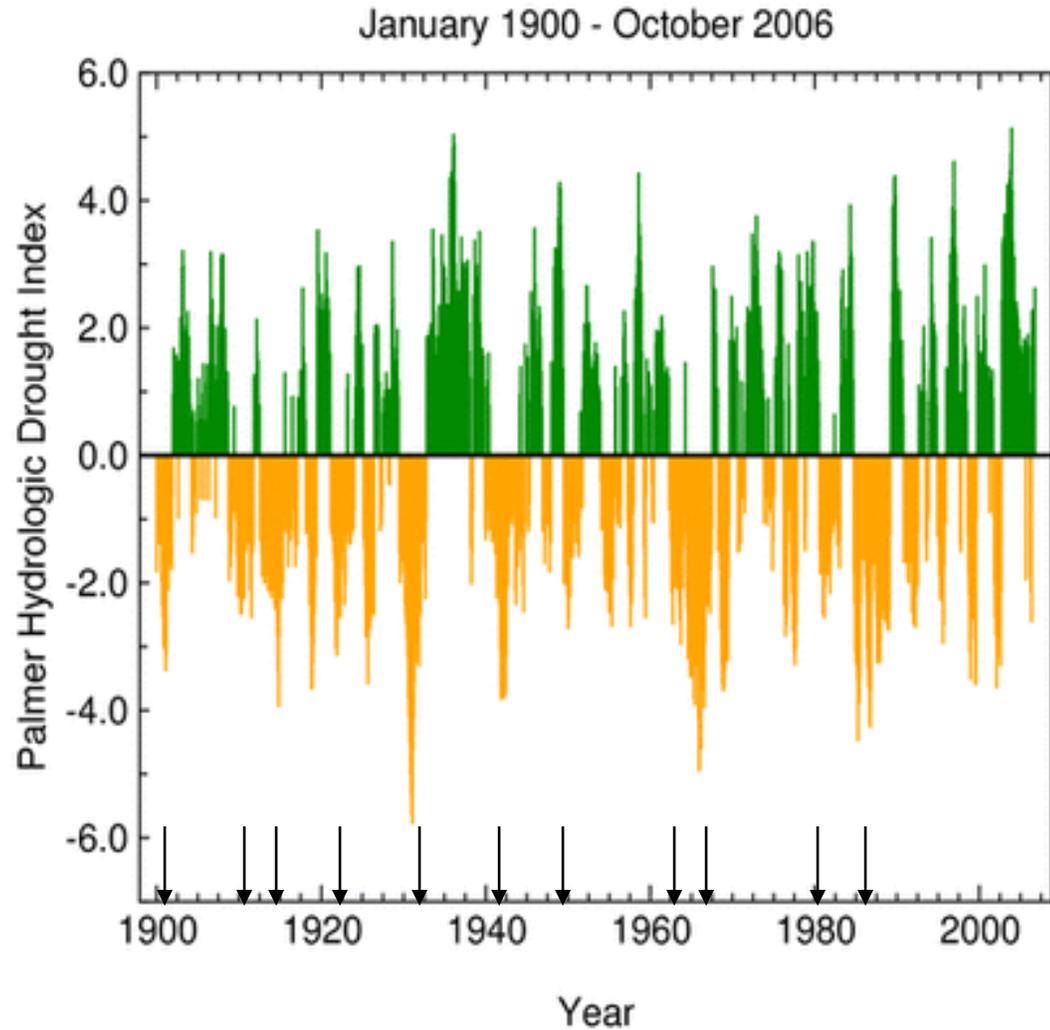
Fresh watera scarce resource

- Only 2.53% of available water is fresh water, of which two-thirds is locked up in glaciers
- Agriculture uses 70% of available fresh water



Source: UN world water development report

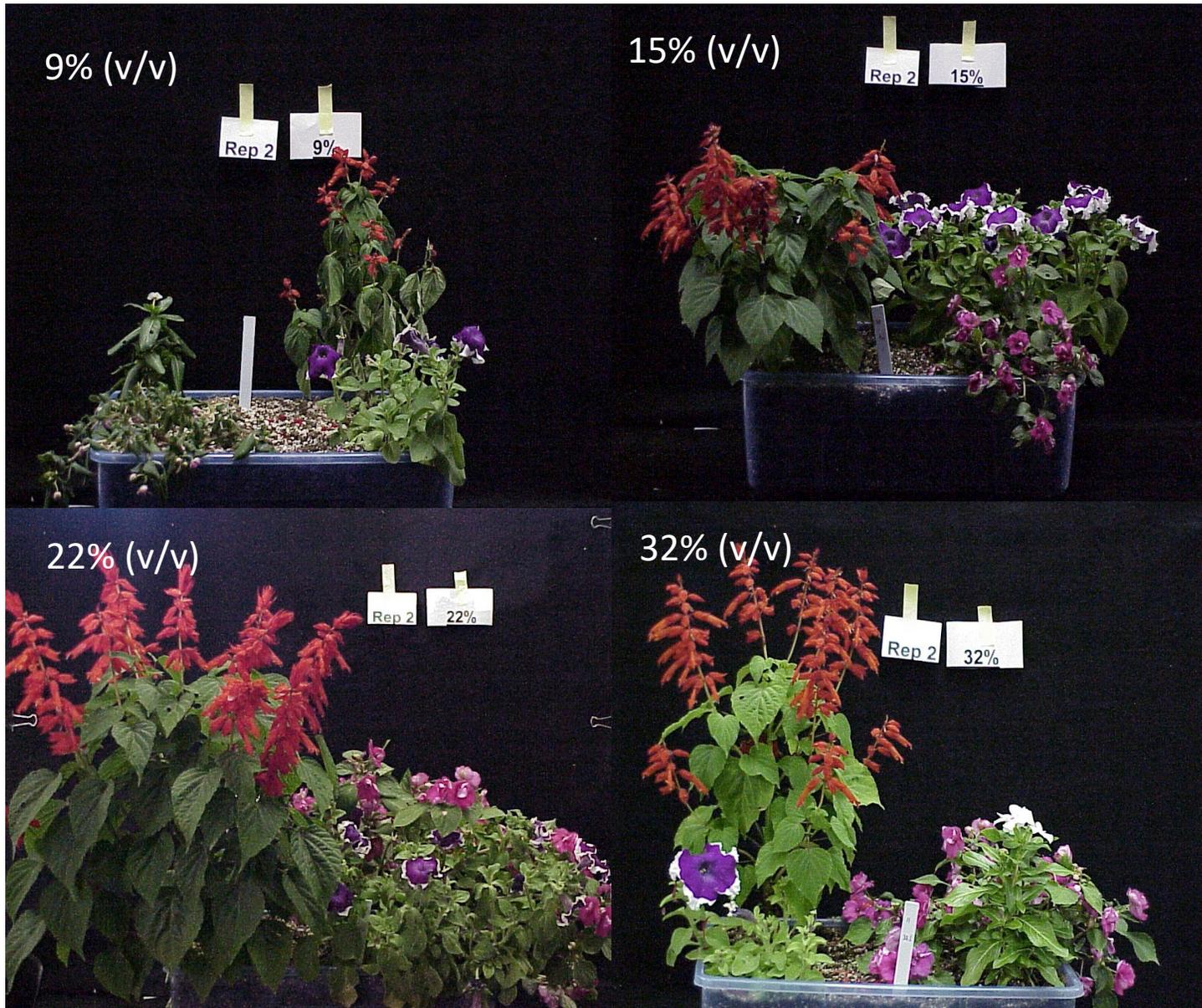
Drought is a major global problem



Number of **wet** and **dry** spells in the last century

Arrows indicate dry spells of 5 consecutive years.

Plant quality affected by too much or too little water



How much water do plants need?

Efficient water use =

∫ [(Application efficiency) + (Retention efficiency) +
(Uptake efficiency) + (Use efficiency)]

Efficiencies associated with water management

- **Water application efficiency**
 - Main influencing factor: irrigation method
 - *Volume of water delivered to the substrate to the total volume applied in irrigation*
- **Water retention efficiency**
 - Main influencing factor: substrate porosity
 - *Volume of water retained by the substrate to the volume delivered*
- **Water uptake efficiency**
 - Main influencing factor: water potential gradient
 - *Volume of water taken by plants to that retained by the substrate*
- **Water use efficiency**
 - Main influencing factor: photosynthesis-transpiration
 - *Biomass produced by water volume taken by plants in transpiration*

Irrigation methods (how to apply)

Over-head irrigation:

- Hand watering
- Sprinkler
- Drip
- Boom irrigation

Sub-irrigation:

- Ebb and flow
- Trough
- Flooded floor
- Float
- Capillary mat



Hand watering

Sprinkler irrigation





Drip irrigation

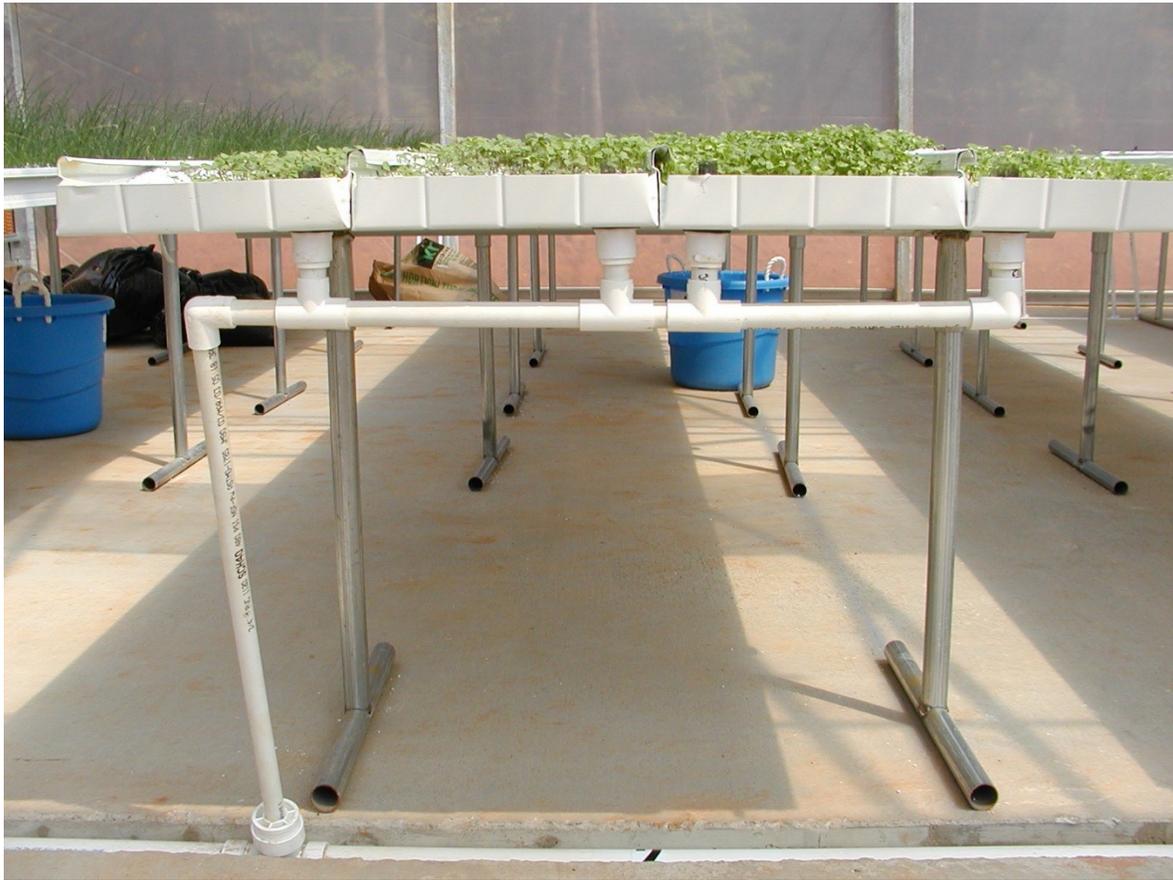
Boom irrigation





Drip irrigation explained





Ebb and Flow

Trough



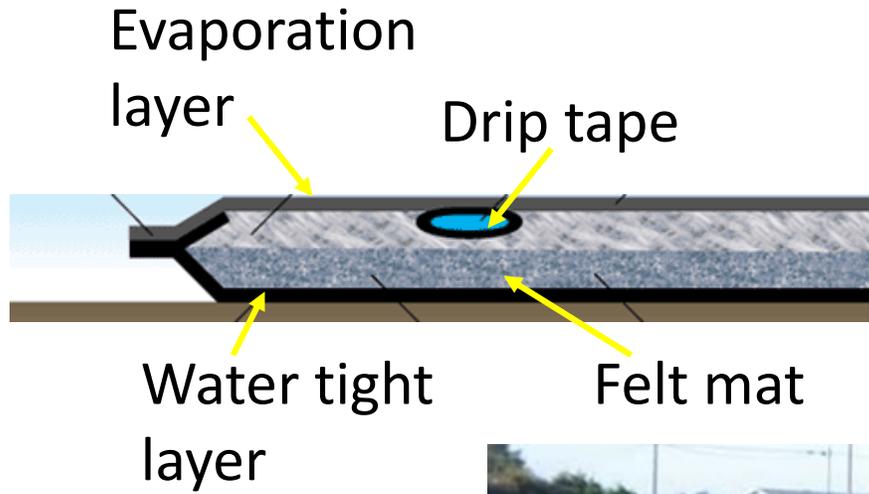


Flooded floor

Float



Capillary mat irrigation



What are the advantages of sub-irrigation compared to overhead irrigation?

- Less wastage/ recirculation and reuse of water no runoff
- Reduced environmental issues/ no leaching of nutrients
- More uniform plant quality
- Lower incidence of diseases

Calculate overall efficiency of water use

Lets assume that 1000 L of water was applied in irrigation to 500 pots

Method of irrigation: sprinkler

- Irrigation application efficiency is 70%
Out of 1000 L applied in irrigation, only 70% or 700 L was delivered to the substrate. This means 300 L of water is wasted in runoff out of 1000 L
- Water retention efficiency is 60%
Out of 700 L delivered to the substrate, only 60% or 420 L is retained by the substrate. This means 280 L of water was leached from the pots
- Water uptake efficiency is 75%
In a peat based substrate, nearly 25% of water is held tightly by pores making it unavailable to plants. Out of 420 L of water retained by the substrate, only 75% or 315 L of water is available for roots to uptake.
- Water use efficiency is ~ 3 g biomass produced per L of water taken by plants
When plants uptake 315 L, nearly 945 g of biomass is produced

Irrigation volume (how much to apply?)

- Irrigation should replace the volume of water lost in evapotranspiration from the pot/ soil
- Many methods exist to determine when to irrigate:
 - Visual observations based on substrate dryness
 - Soil water status based on sensors or lysimetry
 - Plant water status based on wilting, canopy temperature/transpiration

Theta probe



ECH₂O probes



5TE



Capacitance probe



Tensiometer

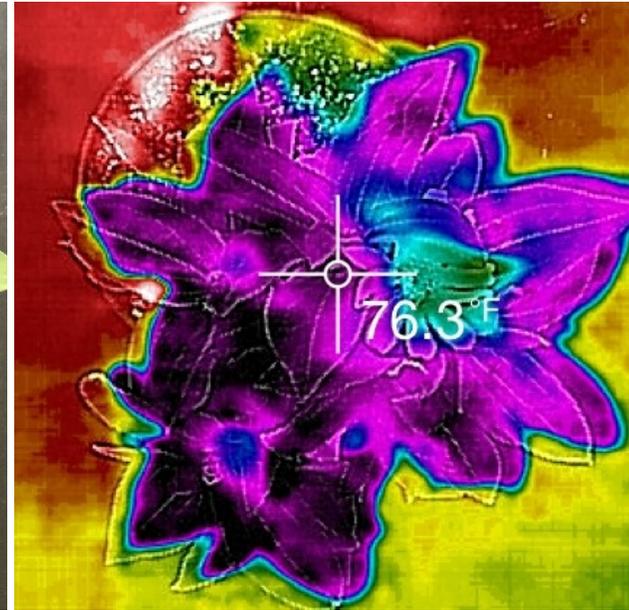


TDR probe

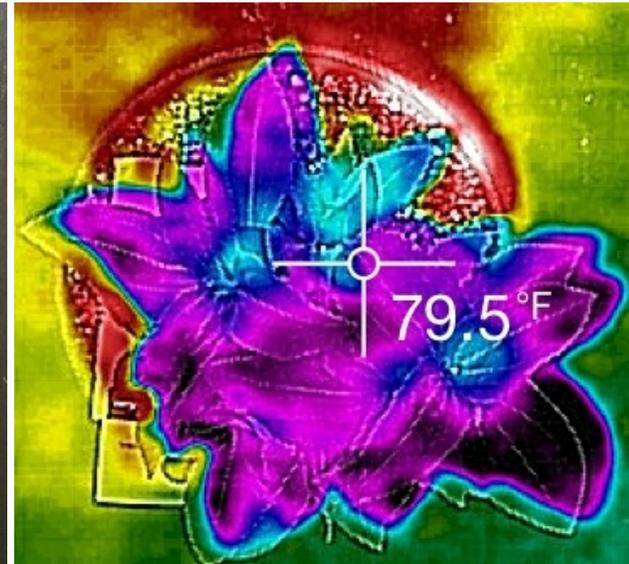


Thermal imaging for crop temperature and water status

Irrigated thrice/week



Irrigated once/week



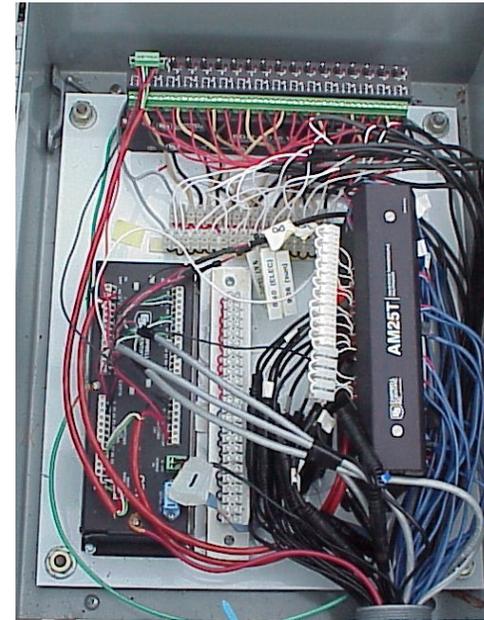
Irrigation timing (when to apply?)

- Timer based
- Soil water status based
- Plant water uptake based

Irrigation Automation



Solenoid Unit



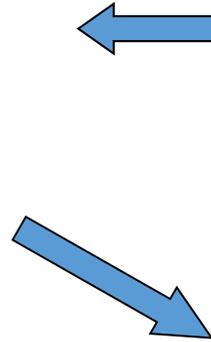
Datalogger/controller

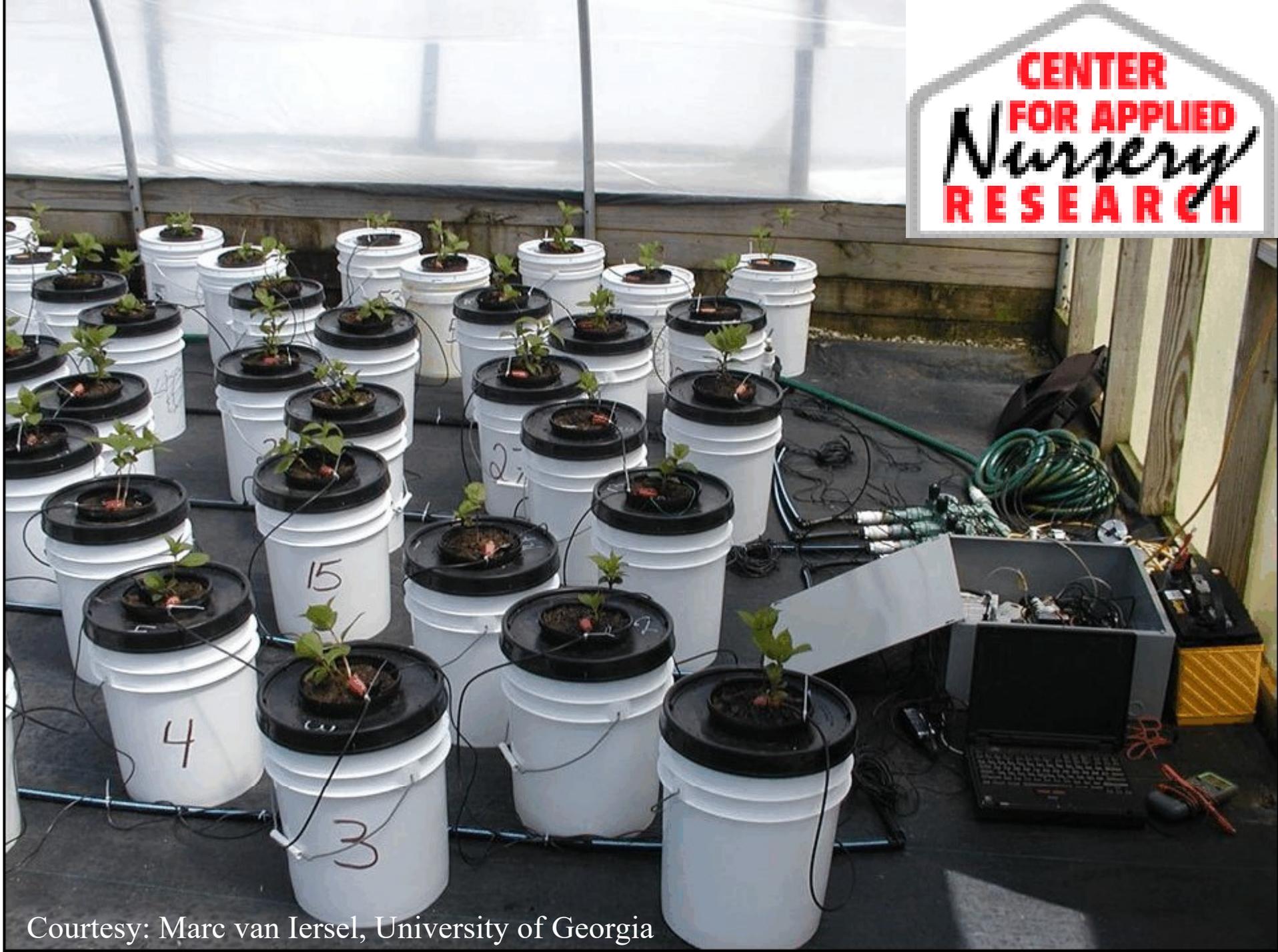


ECH₂O Probes



Sensor in container





Courtesy: Marc van Iersel, University of Georgia

Water requirement of *Hydrangea macrophylla*



The demands we put on our water resources
should not exceed what they can sustain

