Irrigation management in peat-free growing media

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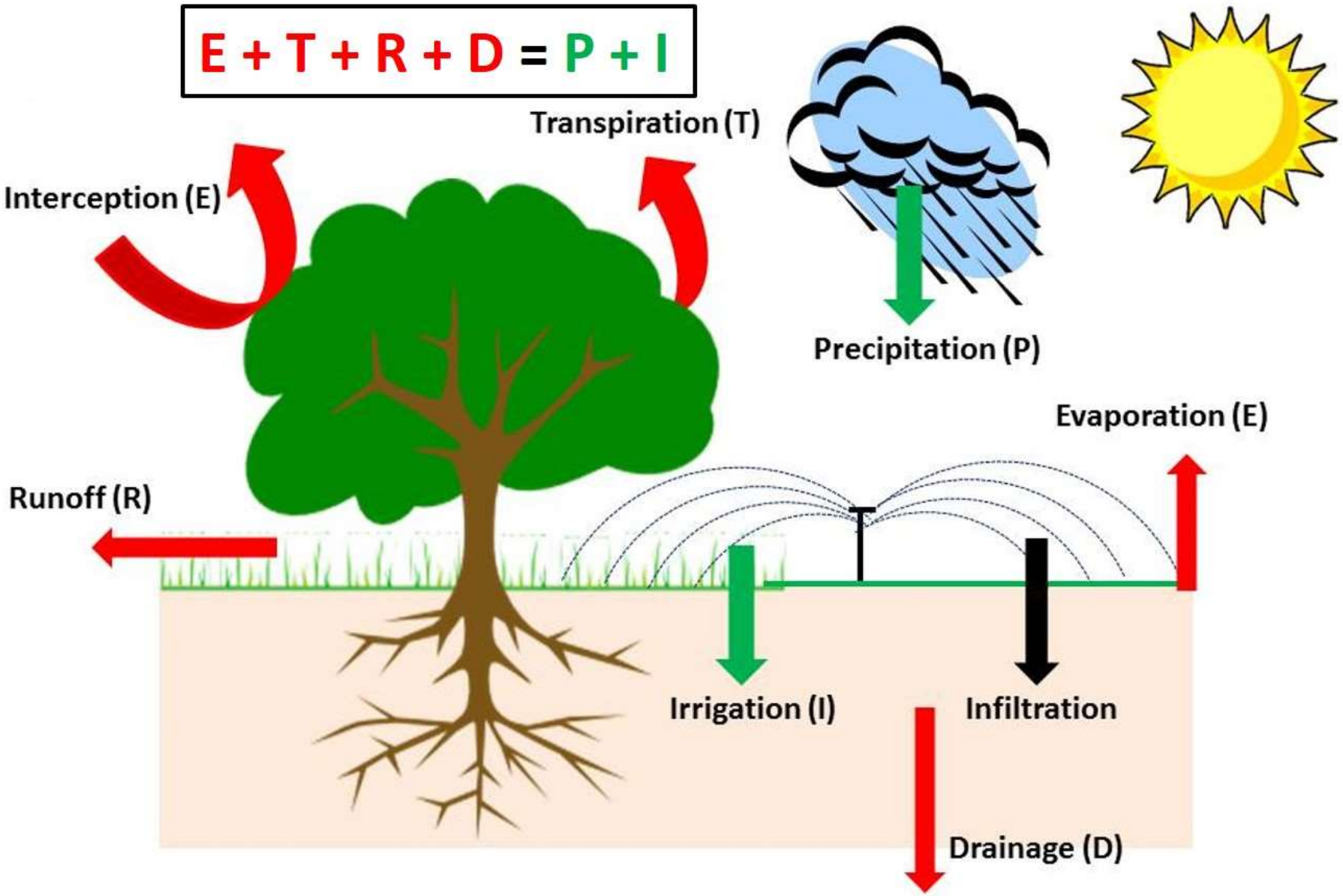

E + T + R + D = P + I
Transpiration (T)
Interception (E)
Precipitation (P)
Evaporation (E)
Runoff (R)
Irrigation (I)
Infiltration
Drainage (D)

Question: How do you irrigate?

By hand or fixed system using expert knowledge

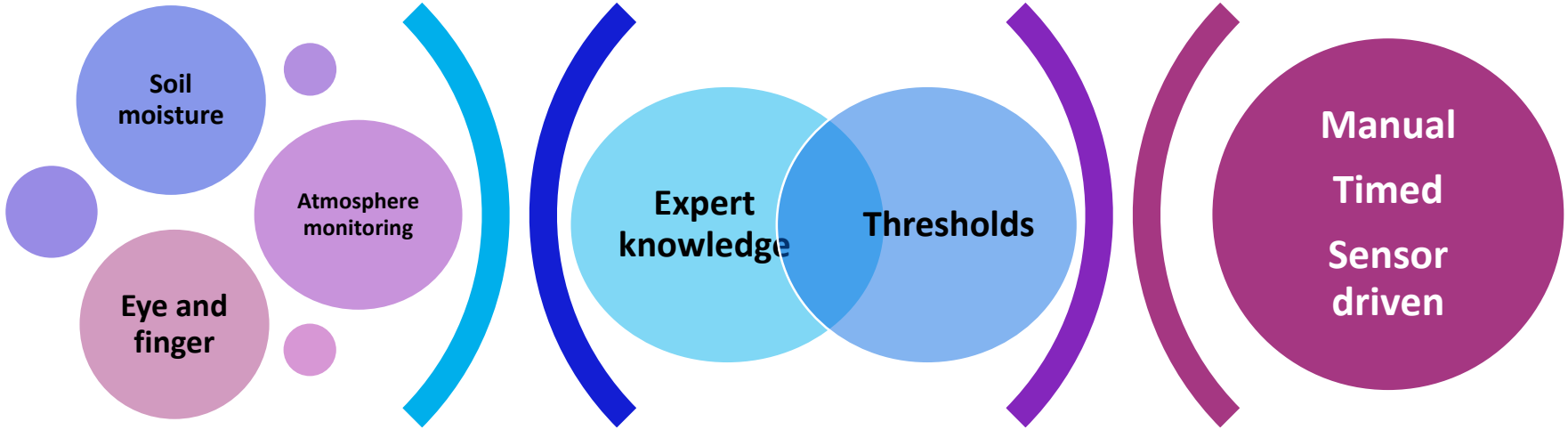
Automated start and stop – usually daily

Automated system based on evapotranspiration

Automated system based on soil-substrate sensors

Components of irrigation control circuit

The objective is to deliver the right amount of water to the plants at the right time. Starting with expert knowledge and experience we can supplement this approach with sensors to monitor the substrate water content and estimate plant water use to better control the amount and timing of irrigation.



What is growing media for?

Physical to support the plant, hold water and air.

Chemical to provide a suitable pH and nutrient environment

Biological to support microbes and fungi which help the plant

Peat has a high level of cell wall structure providing the basis of their functional properties;

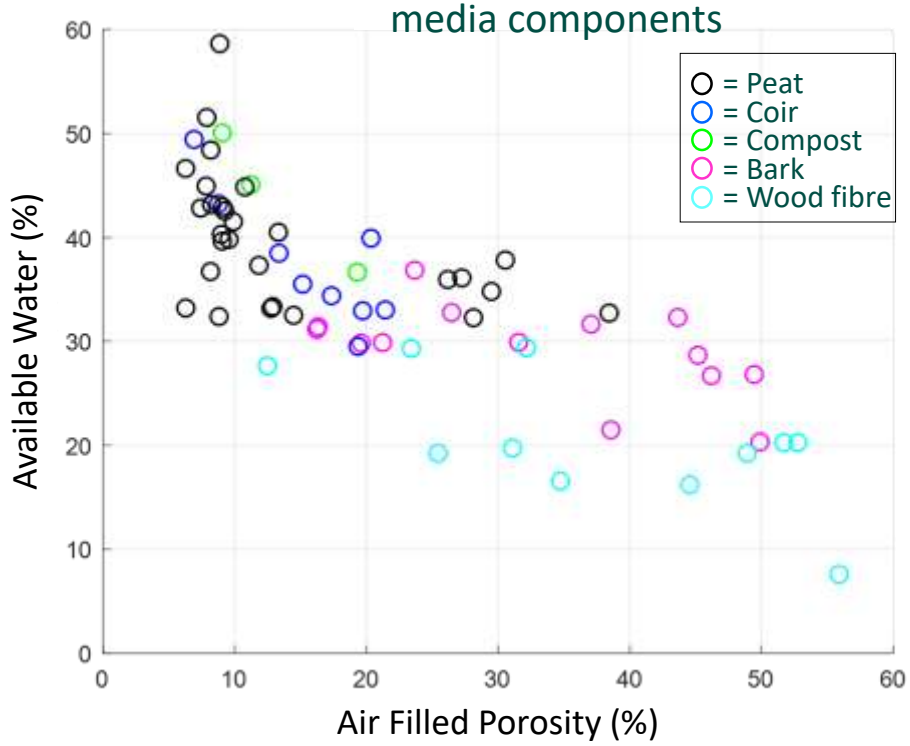
Mature, composted materials lack plant cell wall structure,

Controlled composting can retain plant cell wall structure;

Three physical parameters "Available Water", "Air-filled-Porosity" and "Dry Bulk Density" allow a simple and cheap evaluation of physical suitability as growing media.

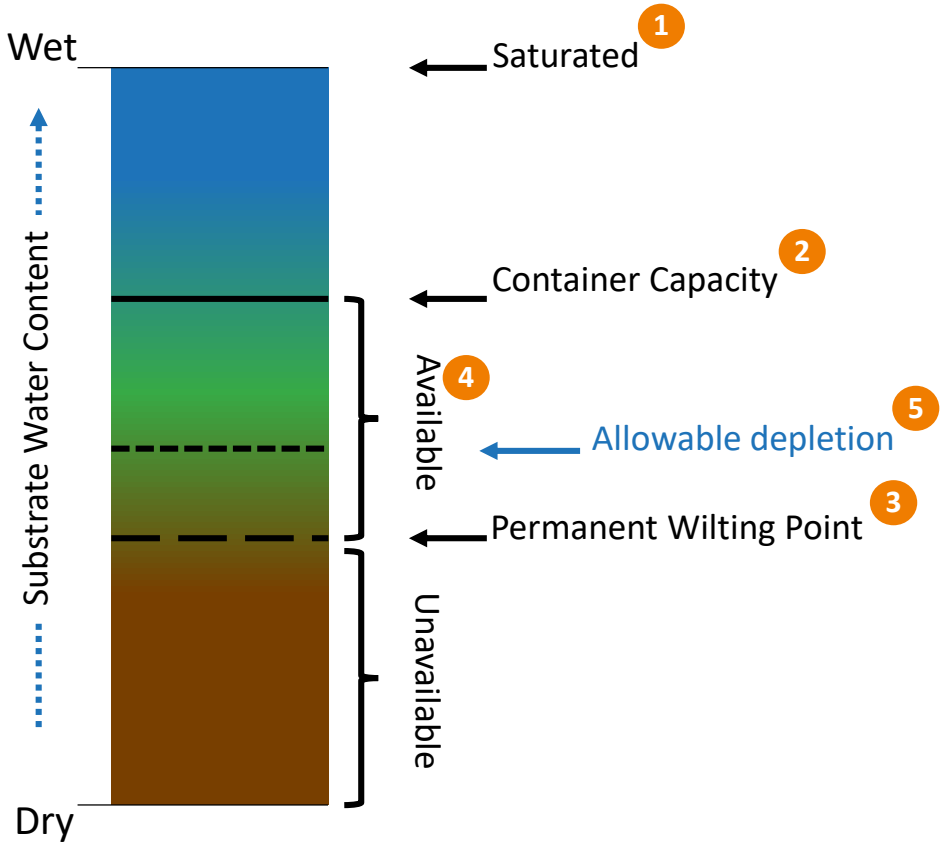
Waldron, et al. (2013). Retaining cell wall structure in producing quality composts to replace peat. Acta Hortic. 1013, 181-188

Comparison of physical characteristics of growing media components



A.D. Watson, et al (2021). Designing rockets and growing media. Acta Hortic. 1305. ISHS 2021.

How much water to use?



Growing substrate is made up of solid particles and spaces that can be filled by air and by water.

1. Saturated means no air spaces that the roots need to function.
2. Field Capacity / Container capacity is the maximum water the substrate can hold.
3. Plants can extract water down to the permanent wilting point.
4. The water available to the plant is the difference between container capacity and permanent wilting point.
5. Allowable depletion is before Permanent Wilting Point and is where the plant can access water without stress

Distribution Uniformity

Efficient irrigation requires application of the right amount of water to the crop. A key factor is how uniform the application is.

We measure the uniformity by catching the irrigation water at many points across the area and comparing the volume captured in the lower quarter to the average of the whole system.

$$DU = 100\ X \left(\frac{Average\ of\ Lower\ Quarter}{Average\ of\ Total} \right)$$

System	Uniformity (%)
Furrow	50 – 70
Centre Pivot	75 - 90
Hand move sprinkler	65 – 85
Overhead sprinkler	70 – 85
Sub surface drip	86 - 90
Surface drip	85 - 95
Capillary matting	-> 100

Acceptable uniformity is generally > 75 %

'Catch-cans' to assess uniformity

How do moisture sensors work?

There are 4 main technologies used in soil moisture sensors.

Most sensors report volumetric water content.

- Electrical resistance – cheap but not high quality
- Dielectric permittivity (various methods)

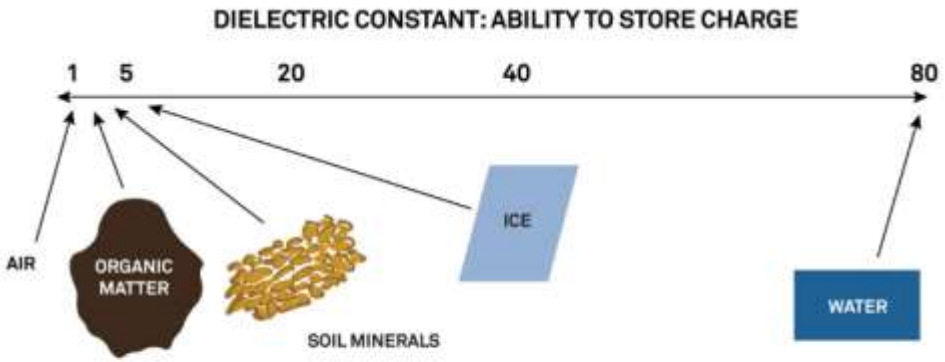
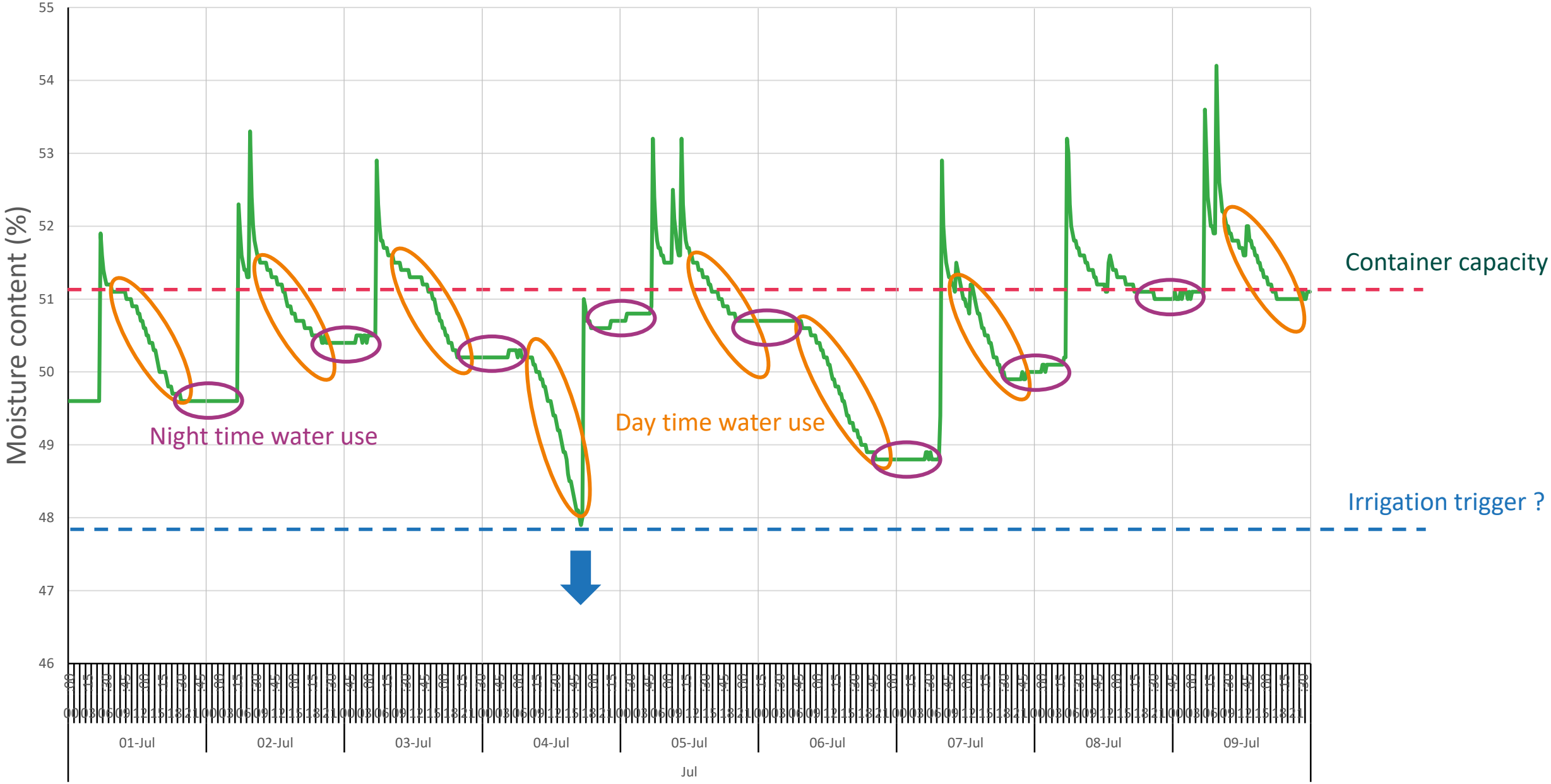


Figure 8. Solids, liquids, and gases all have the capacity to store charge, called their dielectric constant. It is specific to the material and varies over a wide range as shown here.

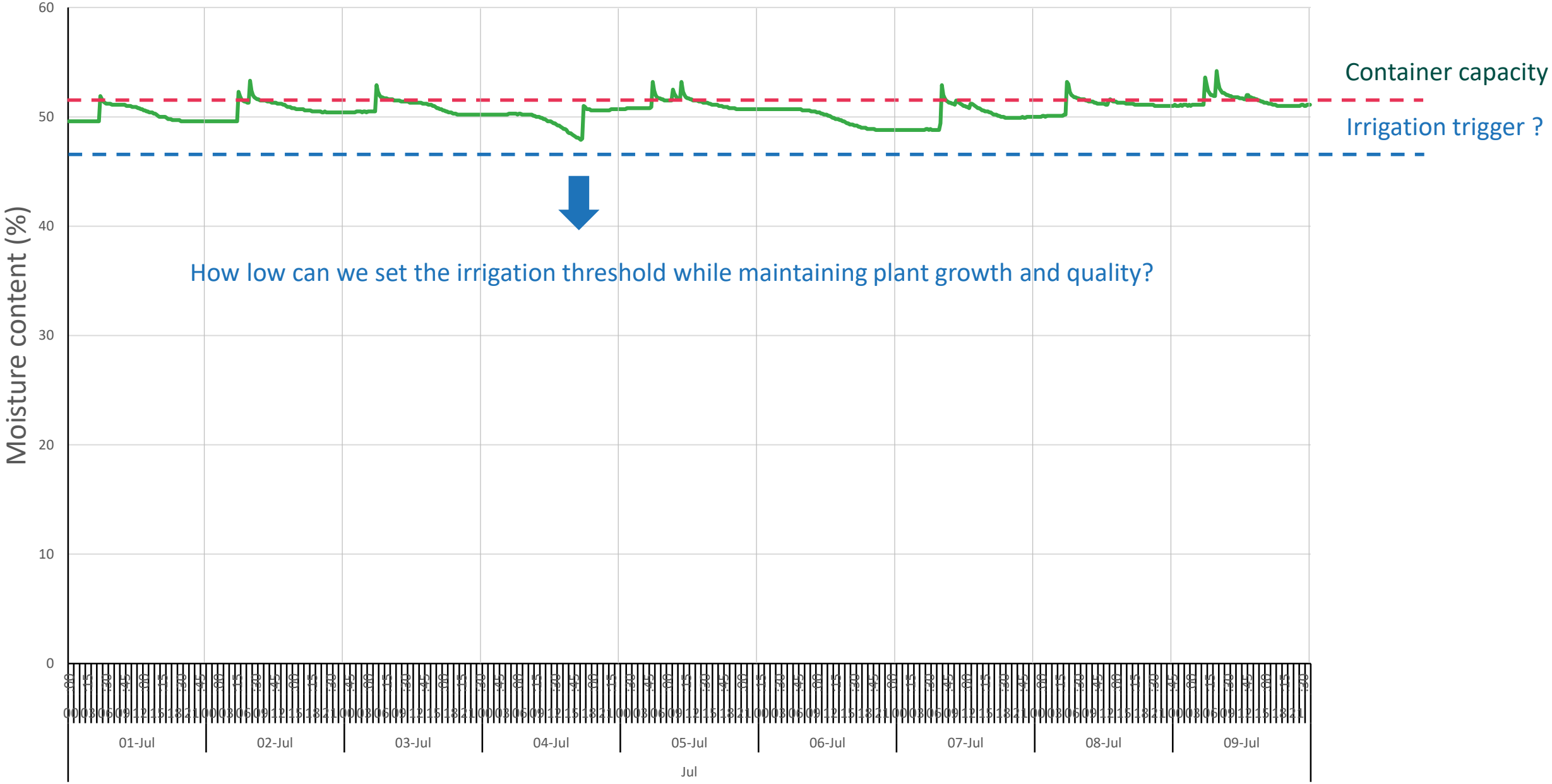
Good sensor calibration is key to success

Example of soil moisture sensor

Substrate moisture thresholds



Substrate moisture thresholds



Nutrient management

For optimum plant growth we need to supply the right amount of nutrition, in the right form, at the right time.

1. Nutrition contained within the planting medium
2. Inorganic – incorporated or as top dressing
3. Controlled release fertilisers
4. Fertigation

Capturing and reusing irrigation water reduces the amount of nutrition lost to the environment.

If we over irrigate then we are washing nutrients out of our growing media and potentially losing them

Concluding remarks

Irrigation management offers at opportunity to manage water and nutrition resources for the economic benefit of your business and to reduce the environmental impact of horticulture.

Changing irrigation management may require infrastructure modification with financial implication. Gov. support available

Peat-free growing media responds differently to peat-based growing media for water holding capacity, drainage and irrigation, so it needs to be managed differently. Higher drainage rates are common.

Wetting agents (included with many brands) assist with wetting-up, but not moisture holding capacity.

Plant requirement for water is driven by the growing environment not by the growing substrate.

Upskilling on watering is recommended through training in technical knowledge combined with regular monitoring.

Concluding remarks

Knowing the amount of water used for plant growth helps right-size the irrigation delivery amount

Improving distribution uniformity achieves a more uniform crop and reduces water wastage

Knowing the thresholds where the substrate is full or plants can still easily extract water informs when and how much to irrigate

Capturing and reusing water from irrigation offers an opportunity to retain nutrition. Plant heath is important. Reusing water requires treatment.

- Sensors can be used to monitor plant water use.
- Periodic physical assessment of system or if any changes are noticed
- Sensors can monitor substrate water content and rate of plant water use.

RHS