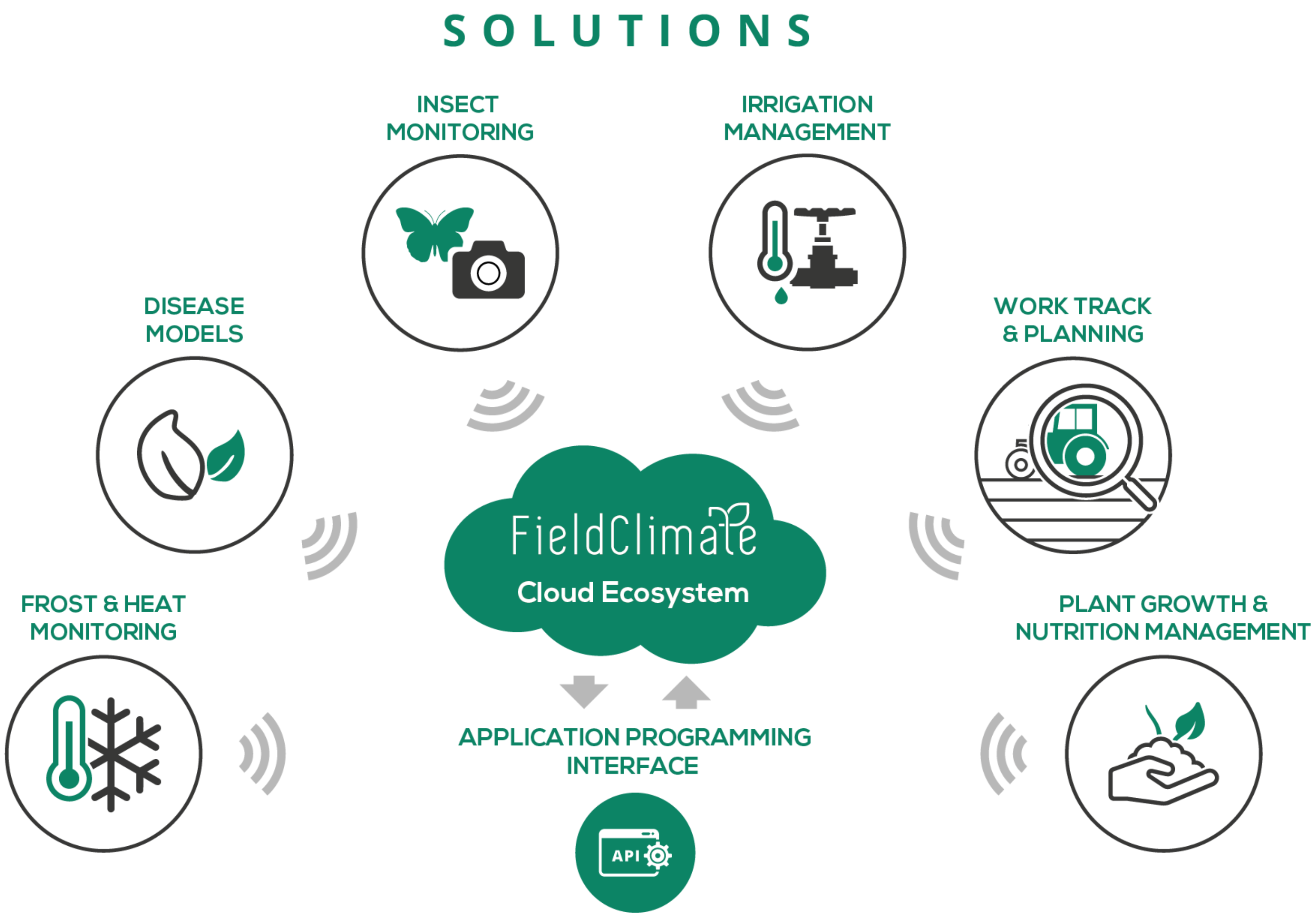
TURNING INFORMATION INTO PROFITS.

Greenhouse Production with METOS® Decision Support System

Pessl INSTRUMENTS

2022

Holistic Solutions for Smart Agriculture



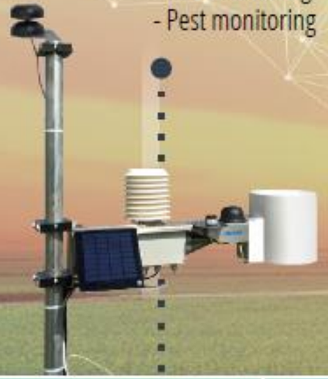
Pessl Instruments DSS Solutions

- In field Monitoring (Weather)
- Weather Forecast Modelling
- Disease Forecast Modelling
- Crop Monitor
- Insect Monitor
- Soil Moisture Monitor
- Soil Analyses
- Fertility Monitor
- Storage / Tank Monitoring
- GPS Work Tracking on machines

Active Alert/Automation

- Accident Warning System
- Frost warning systems
- Automation in Irrigation

Timeline for conversion to the smart agriculture with METOS®



Oct

It is time to choose the best IoT devices you need for:
- Weather monitoring
- Crop monitoring
- Soil monitoring
- Pest monitoring

Nov

Order in advance to avoid waiting for products during the High Season.
You will receive your IoT devices in the shortest time.

Dec

At the **end of the growing season** it is the best time for the installation of monitoring devices and setting the devices according to your needs.

Jan

It's very important to have accumulated data from the beginning of the year for:
- Disease modeling
- Pest monitoring
- Full annual data
- Yield prediction

Feb

Before the season starts use the time to get familiar with the fieldclimate.com interface to gain better understanding and practical skills for the coming season.

Mar

The beginning of field monitoring and using solutions for:
- Seeding campaign
- Disease monitoring
- Frost monitoring
- Soil moisture monitoring

Apr

The crucial period for:
- Fertilizer application
- Fighting diseases
- Pest prevention
- Frost prediction
- Soil temperature
- Crop establishing
- Yield predicition

May

Main period for modeling and adapting technologies of cultivated crops to **local weather** to ensure a good yield and its quality.

Jun

Time for using special tools like:
- Particular work planning
- Crop monitoring
- Satellite images
- Crop stress evaluation

Jul

Monitoring of important parameters:
- Evapotranspiration
- VPD - Crop health
- Delta T - for spraying
- Soil water balance

Aug

Yield estimation period:
- Crop maturity status
- Fruit size
- Sugar content
- Nutrient content
- Leaf turgor status

Sep

Tools needed for harvesting period:
- Weather forecast
- Field conditions predictor
- Dew point
- Leaf wetness
- Crops dedicated harvest planner

Value Proposition

Sustainability

Higher ROI

Optimize resources (inputs, water, energy , time …)

Better planning

Improve quality

Reduced environmental impact

Food security

Save and increase yield

Theory & Challenges

Challenges for Greenhouse Growers

Although it may be difficult to create the perfect greenhouse climate for growing plants, there are variables growers can control to maximize plant growth.

Regardless of the type of crop being grown in a greenhouse, the climate a grower is trying to achieve requires controlling the same variables.

Greenhouse growers are trying to control **temperature, humidity, light level, carbon dioxide**, and in some instances, airflow and air distribution. Depending on the crop, these variables have different set points. They also might have different acceptable maximum and minimum ranges or levels.

Relative Humidity

Relative humidity is a critical climate parameter in the cultivation of any crop. So most growers aim to maintain optimal humidity ranges, corresponding with the plants they grow.

The optimal relative humidity setpoint for most plants is around 80%. At this level, growth rates are highest for common greenhouse plants. At higher or lower humidity levels, plant physiological processes may slow down, leading to slower growth and lower quality output.

High relative humidity levels also drastically increase the susceptibility to common humidity diseases such as botrytis or powdery mildew.

Humidity is a climate parameter that growers should understand, control and maintain to suit their target crops, rather than simply attempt to reduce it to a minimum.

Optimal Greenhouse Humidity – 80%

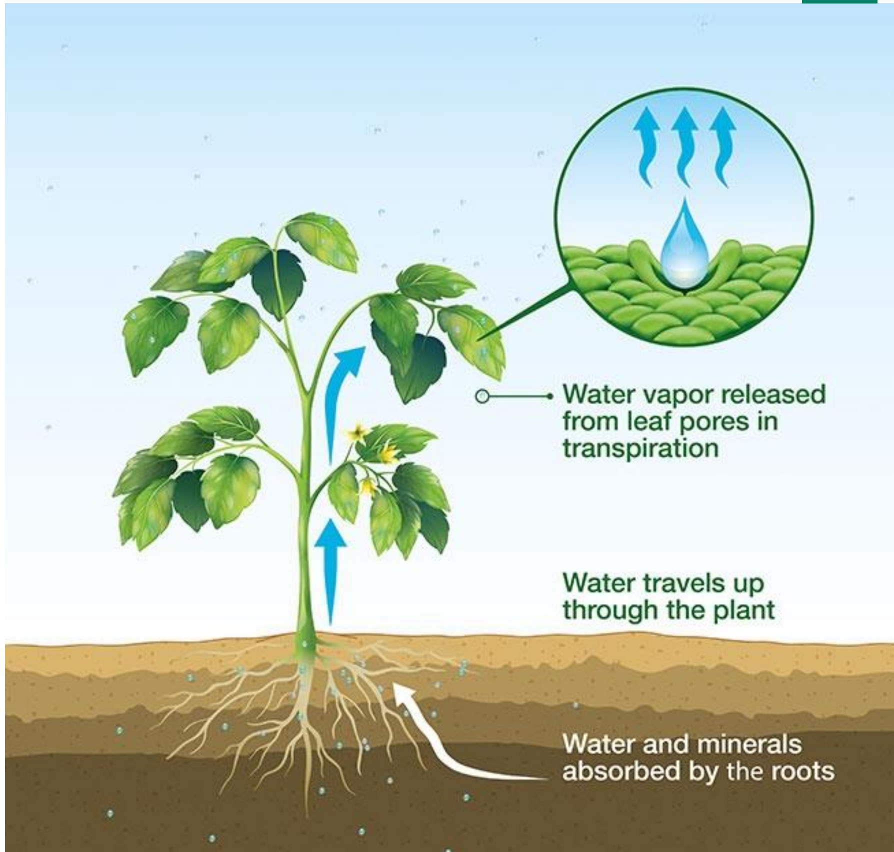
Relative Humidity & Nutrient Transport

There are many factors that affect plants' ability to take in nutrients and spread them to the cells within the plant. One of the most effective ways to **improve** nutrient transport is **humidity control**.

Relative humidity – humidity has a direct impact on the rate at which plants transpire. Generally, higher humidity will slow down transpiration and lower humidity will speed it up. But if relative humidity is too low, or too high, nutrient transport will slow down or stop completely.

In order for plants to transpire, the air surrounding them (the boundary layer) must be able to take in more water vapor. If the air has already reached the dew point, as in 100% saturation, there is no where for the water vapor to go. In this case, water will simply cease to evaporate, halting the xylem pull and stopping nutrient transport in the plant.

But extremely low humidity has its problems as well. When the air is too dry, water evaporates at a rapid rate. So, to protect themselves from extreme water loss, plants enter a state of stress, in which they close their stomata in an attempt to retain water. When plants close their stomata, they barely transpire, leading to similar results as high humidity.



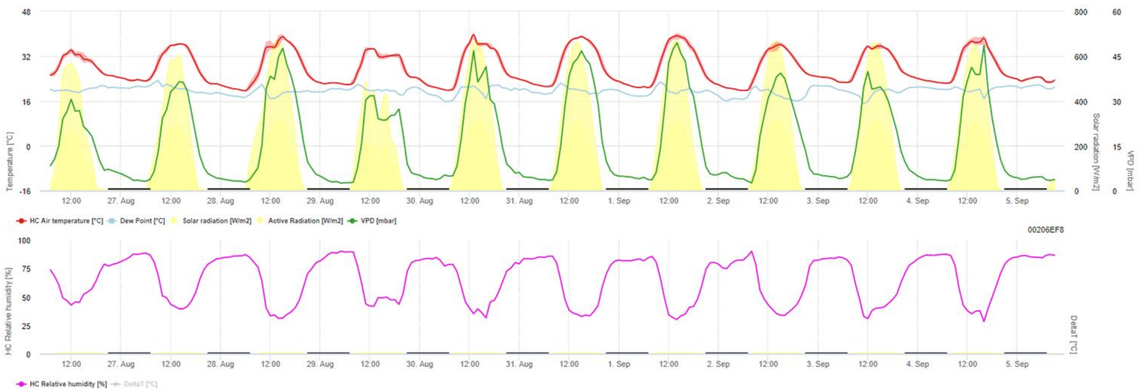
Air Temperature

Temperature is an important environmental factor that influences the growth of greenhouse crops. There are three important temperature points in plant growth:

- minimum temperature
- optimum temperature
- maximum temperature

They are called cardinal temperatures.

Using the minimum temperature (or base temperature) we can subjectively place crops into different temperature response categories: cold-tolerant plants, cold-temperate plants, and cold-sensitive plants. Crops do not respond in the same manner to temperatures at all stages of growth. For example, the optimum temperature for vegetative growth may not be suitable for flower development. Night temperatures that are too warm or too cold are more often than not, much more damaging to crops than day temperatures. The actual temperature of a plant affects how slow or fast a crop develops.



Temperature Requirements for Crop Growth Stages

When contemplating greenhouse temperature management, it is important to take into consideration the influence of temperature on plant growth and development for the various stages of growth—seed germination, vegetative phase, reproductive phase, and ripening phase. A plant species optimum temperature changes as a plant grows from a seedling to a mature plant.

Generally, seed germination and early seedling growth occurs most rapidly at warmer temperatures. Warmer temperatures are generally favored by younger plants. Even though warmer temperatures cause increased rates of both photosynthesis and respiration, warmer temperatures favor photosynthesis and net growth in younger plants since there is less stem and root tissue compared to older plants.

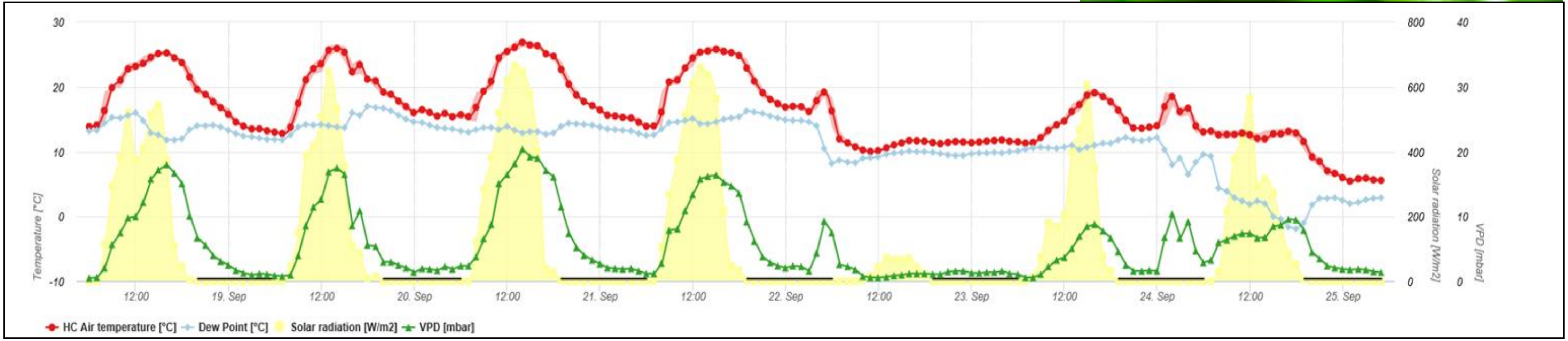
Temperature Influence of Plant Quality

There is often a trade-off between high quality crops and crop timing. Cooler temperatures typically produce higher quality plants (especially cold-tolerant crops), but they take longer to reach maturity, and energy consumption per crop can be higher. Whereas crops grown at warm temperatures develop faster and thus have shorter crops times and require less energy for heating, but the quality of plants is often not as high. For example, transplants and plugs grown at cool temperatures they often have thicker stems, better rooting, and greater branching.

Dew Point

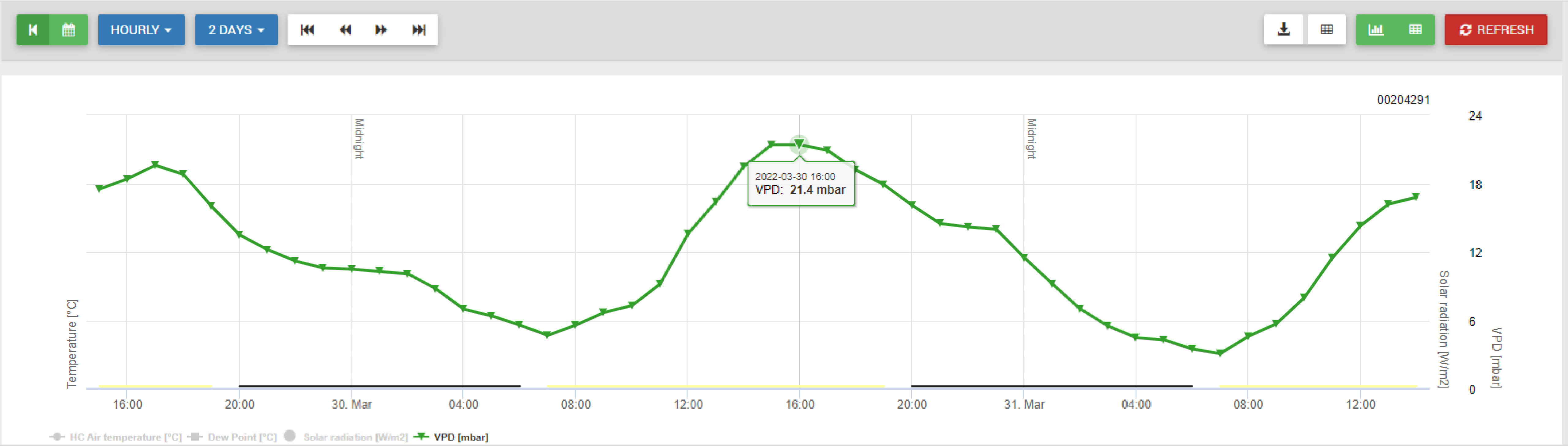
Dew Point Temperature:

- The dew point is the temperature the air needs to be cooled to (at constant pressure) in order to achieve a relative humidity (RH) of 100%. At this point the air cannot hold more water in the gas form. If the air were to be cooled even more, water vapor would have to come out of the atmosphere in the liquid form, usually as fog or precipitation.
- Although Dew point temperature is not forecasted, it's calculate for each METOS® weather station (hygroclip needed)
- Understanding the dew point and the factors that affect it provide us a better understanding of what's really going on in the greenhouse. What really happens when we heat up or allow the air to cool down. It's not just about temperature, it's about humidity as well and the dew point encapsulates this.



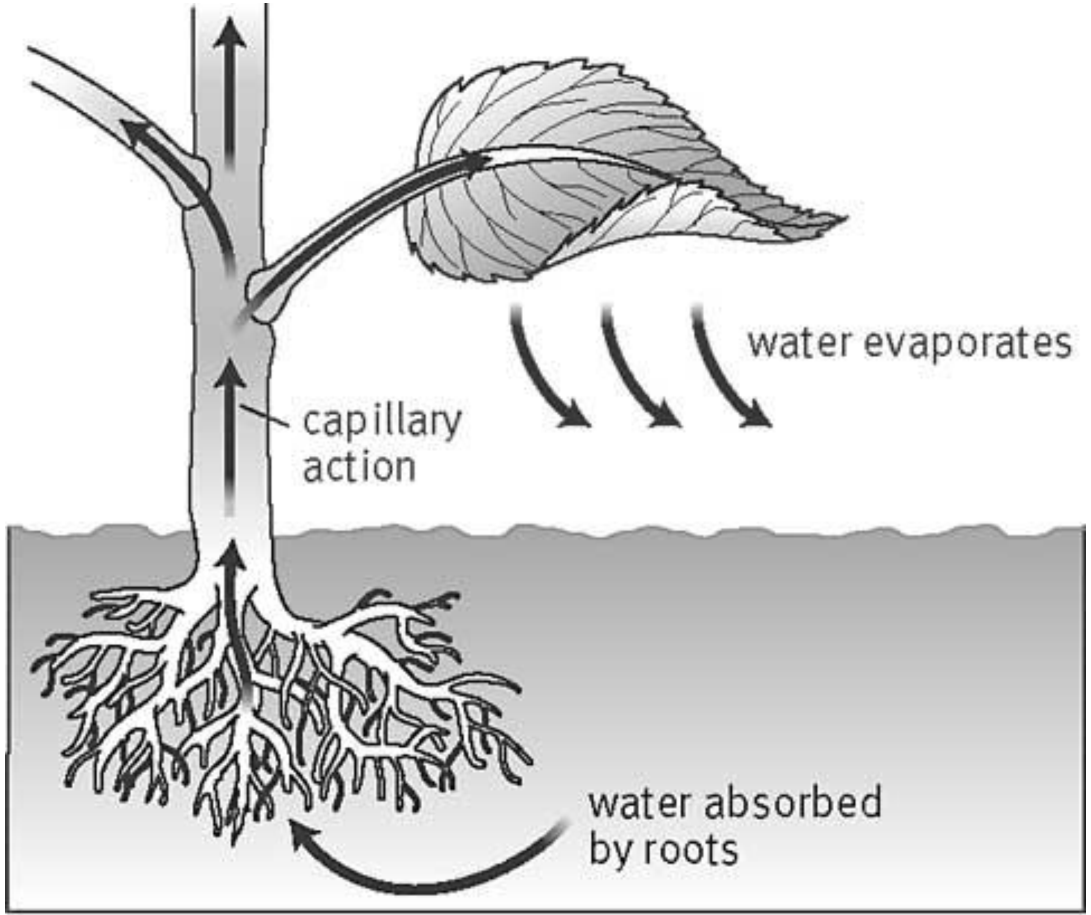
Vapour Pressure Deficit

Vapor Pressure Deficit (VPD) is an indicator of the evaporation potential of water to the air. It's a measurement that's defined as the difference, or deficit, between pressure exerted by the moisture present in the air currently and the pressure at saturation. It's one of several different methods that you can use to evaluate crop stress or water stress within a plant.



Vapour Pressure Deficit

The VPD can be used to steer plants based on the concept that it affects the transpiration stream within the plants. When plants transpire, they're not just pulling water and cooling themselves, they're also pulling mineral nutrition from the water such as calcium and magnesium and transporting it through their xylem.



Any minerals or nutrients present in the water get pulled in through the roots and up the xylem

Vapour Pressure Deficit

Vapour pressure (in mbar)

°C	°F	95%	90%	85%	80%	75%	70%	65%	60%	55%	50%	45%	40%	35%
15	59	0.8	1.7	2.5	3.4	4.2	5.1	5.9	6.8	7.6	8.5	9.4	10.2	11.1
16	60.8	0.9	1.8	2.8	3.7	4.6	5.5	6.4	7.3	8.2	9.1	10.00	10.9	11.8
17	62.6	1.0	2.0	2.9	3.9	4.9	5.8	6.8	7.8	8.8	9.7	10.6	11.6	12.6
18	64.4	1.0	2.0	3.1	4.1	5.1	6.2	7.2	8.2	9.3	10.3	11.3	12.4	13.4
19	66.2	1.1	2.2	3.3	4.4	5.5	6.6	7.7	8.8	9.9	11.0	12.1	13.2	14.3
20	68	1.2	2.4	3.5	4.7	5.9	7.0	8.2	9.4	10.6	11.7	12.8	14.0	15.2
21	69.8	1.2	2.4	3.7	4.9	6.2	7.4	8.6	9.9	11.1	12.4	13.7	14.9	16.1
22	71.6	1.3	2.6	3.9	5.3	6.6	7.9	9.2	10.5	11.9	13.2	14.5	15.8	17.2
23	73.4	1.4	2.8	4.2	5.6	7.0	8.5	9.9	11.3	12.7	14.1	15.4	16.8	18.2
24	75.2	1.5	3.0	4.5	5.9	7.4	8.9	10.4	11.9	13.4	14.9	16.4	17.9	19.4
25	77	1.6	3.2	4.8	6.4	8.0	9.5	11.1	12.7	14.3	15.9	17.4	19.0	20.5
26	78.8	1.7	3.4	5.1	6.7	8.4	10.1	11.8	13.4	15.1	16.8	18.4	20.1	21.8
27	80.6	1.8	3.5	5.3	7.1	8.9	10.7	12.4	14.2	16.0	17.8	19.6	21.3	23.1
28	82.4	1.9	3.8	5.7	7.6	9.5	11.4	13.3	15.1	17.0	18.9	20.7	22.6	24.5
29	84.2	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.1	24.1	26.1
30	86	2.1	4.2	6.4	8.5	10.6	12.7	14.8	17.0	19.1	21.2	23.3	25.4	27.5
31	87.8	2.2	4.5	6.7	9.0	11.2	13.4	15.7	17.9	20.2	22.4	24.6	26.9	29.1
32	89.6	2.4	4.7	7.1	9.5	11.9	14.2	16.6	19.0	21.3	23.7	26.1	28.4	30.8
33	91.4	2.5	5.0	7.5	10.0	12.5	15.0	17.6	20.1	22.6	25.1	27.6	30.1	32.6
34	93.2	2.7	5.3	8.0	10.6	13.3	15.9	18.6	21.2	23.9	26.5	29.2	31.8	34.5
35	95	2.8	5.6	8.4	11.2	14.0	16.8	19.6	22.4	25.2	28.0	30.8	33.6	36.4

- Low VPD level
- Suboptimal VPD level
- Optimal VPD level
- Over optimal VPD level
- High VPD level

Vapour Pressure Deficit

The influence of VPD on plants

Low VPD level

- Transpiration is stifled by inability to release moisture to the air
- Moisture on plant surfaces leads to disease problems

Optimal VPD level

All processes under normal

High VPD level

- The high VPD means the pressure inside your plants is much higher than in the outside air.
- The plants will transpire lots of moisture into the air.
- It can dry out their stomates.
- It creates stress responses that use up your plants' energy and metabolism trying to deal with high VPD rather than growth.

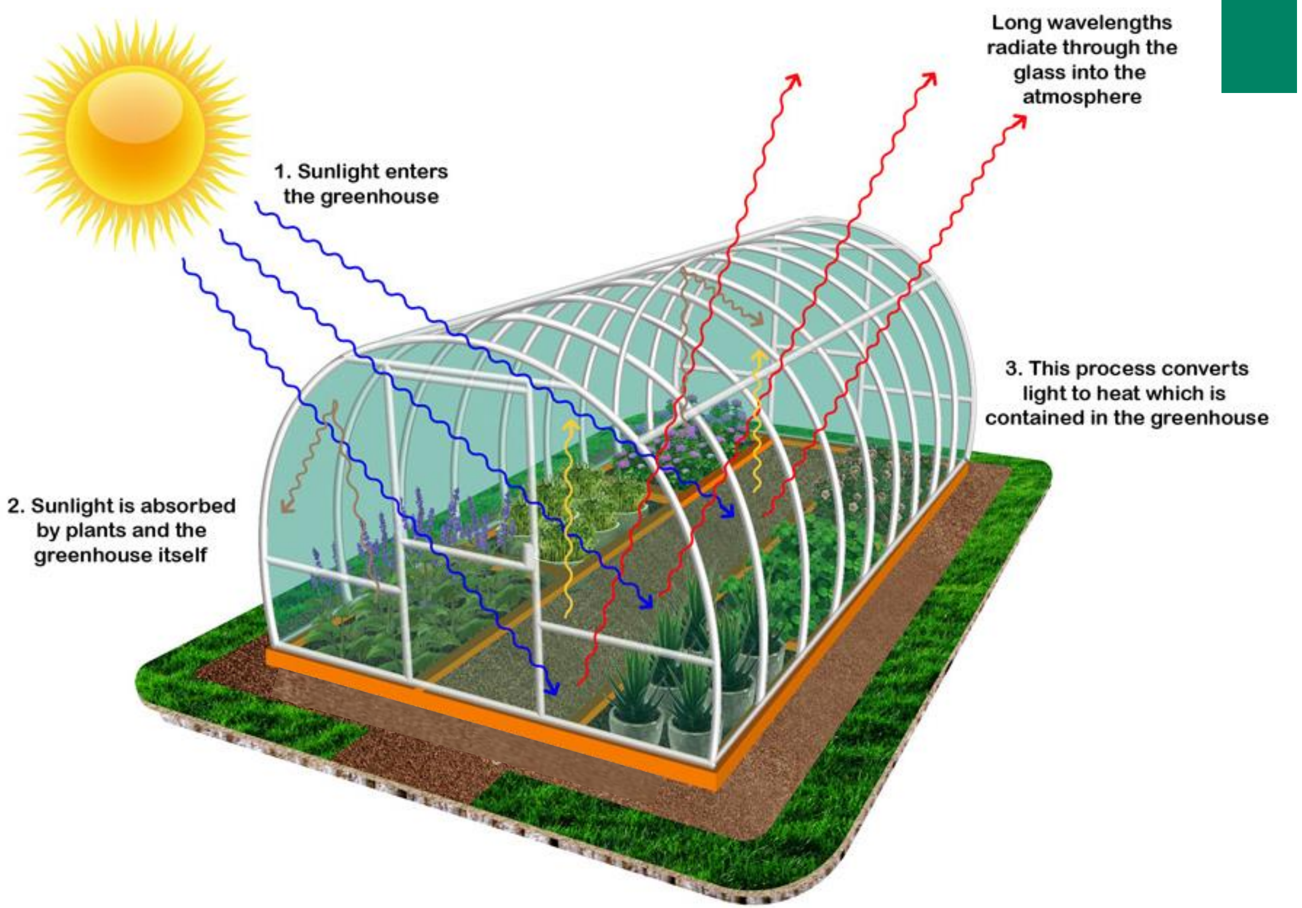
Plant Temperature

It is important to consider the actual plant temperature during production and not just the air temperature. During the day, air temperature, shortwave radiation, and transpiration have the largest effect on plant temperature. Heat can move from the air to the plant, or vice versa, through a process called convection. Shortwave radiation that is not absorbed by leaves for photosynthesis is either reflected or transmitted through the leaf and can increase plant temperature. As radiation from the sun increases, plant temperature increases unless leaves can dissipate heat through transpiration or convection. Plant temperature can also increase above the air temperature if light is delivered from high-intensity lighting, such as high-pressure sodium or metal halide lamps.

Light in the Greenhouse

Plant growth is influenced by both the quality and intensity of light reaching the leaves.

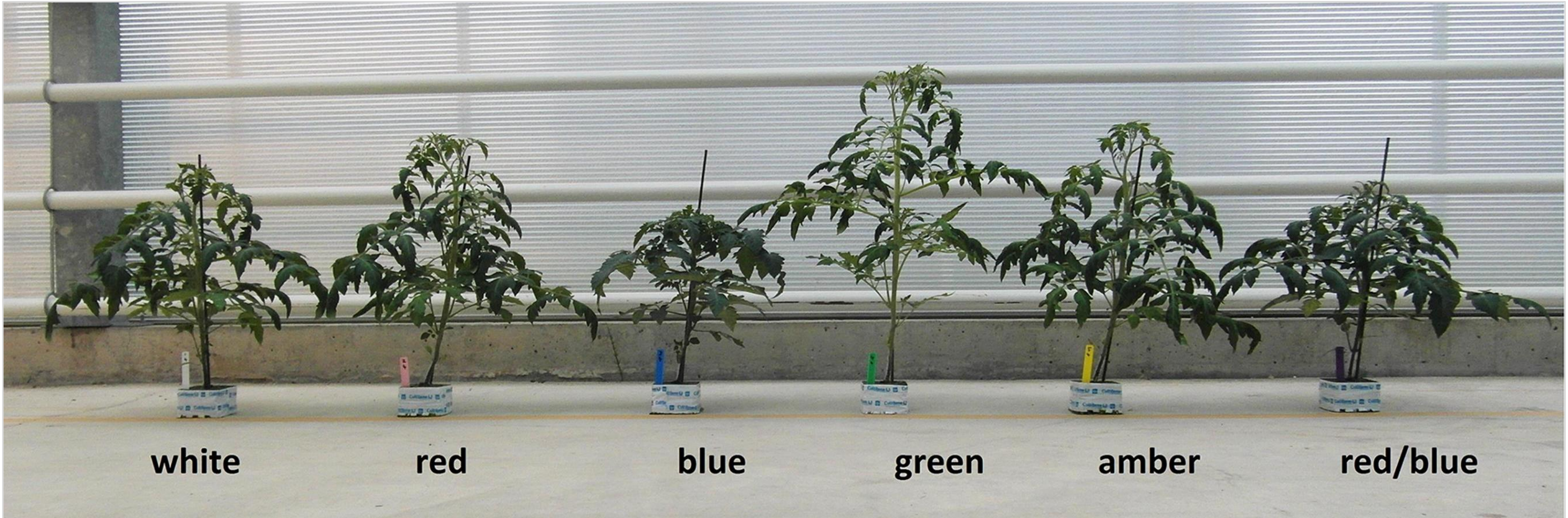
Light intensity or light quantity refers to the total amount of light that plants receive. Light intensity drives photosynthesis which, in turn, produces the carbohydrates which serve as the building blocks for plant growth. In contrast to light quality, the description of the intensity of light does not consider wavelength or color. The intensity of light can change with the time of the day, season, geographic location, distance from the equator, and weather. It gradually increases from sunrise to the middle of the day and then gradually decreases toward sunset; it is high during summer, moderate in spring and fall, and low during wintertime.



Effects of Light on Plant Growth

A balance of light across the PAR range is preferable and when providing shade, reduced intensity across the full spectrum is assumed to be better than reducing particular color wavelengths.

Effect of spectral composition of the light on plant morphology of tomato plants grown under white, red, blue, green, amber and red/blue LED light during 21 days:



Light Requirements for Plants

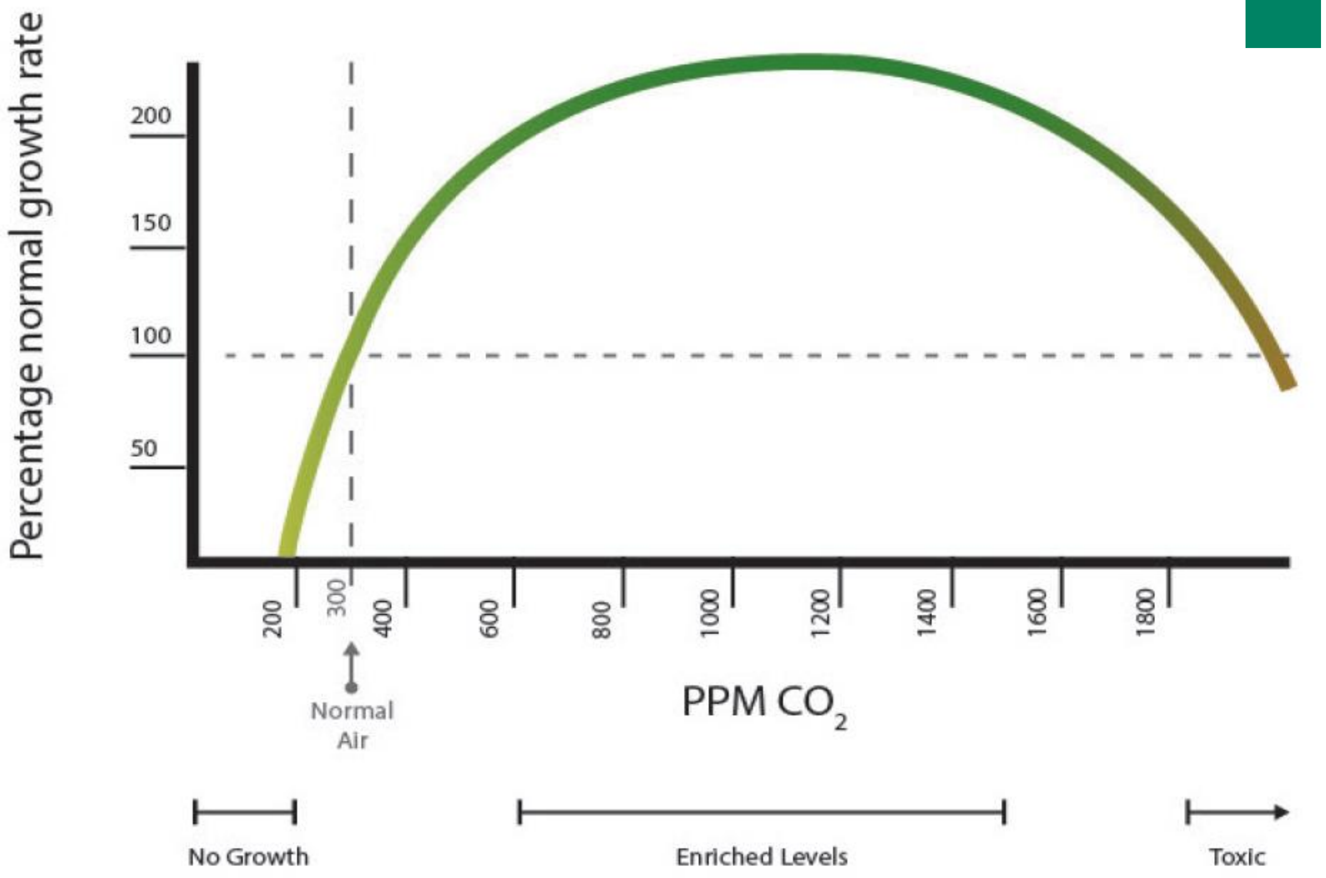
Supplemental light can increase growth and accelerate production of greenhouse crops, but it can be expensive if not provided in a way that promotes efficient use of the light.

Appearance of Rudbeckia fulgida var. sullivantii plants as a function of photoperiod. All plants received a daily light integral (DLI) of 12 mol·m–2·d–1, except for plants that received no supplemental light (mean DLI of 5.0 mol·m–2·d–1)

Carbon Dioxide in Greenhouses

Carbon dioxide (CO2) is an essential component of photosynthesis (also called carbon assimilation). Photosynthesis is a chemical process that uses light energy to convert CO2 and water into sugars in green plants. These sugars are then used for growth within the plant, through respiration.

The difference between the rate of photosynthesis and the rate of respiration is the basis for dry-matter accumulation (growth) in the plant. In greenhouse production the aim of all growers is to increase dry-matter content and economically optimize crop yield. CO_2 increases productivity through improved plant growth and vigor. Some ways in which productivity is increased by CO_2 include earlier flowering, higher fruit yields, reduced bud abortion in roses, improved stem strength and flower size. Growers should regard CO_2 as a nutrient.

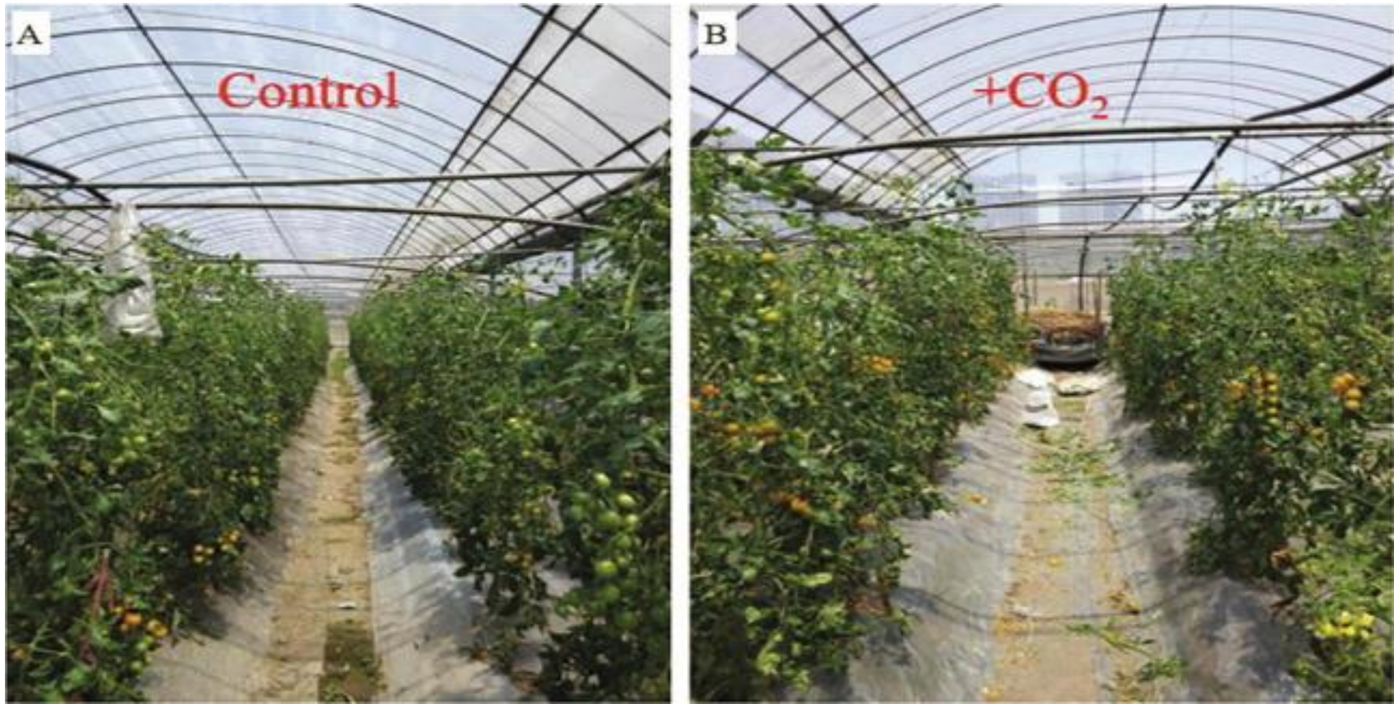


CO_2 Requirements for Plants in Greenhouses

For the majority of greenhouse crops, net photosynthesis increases as CO_2 levels increase from 340–1,000 ppm (parts per million). Most crops show that for any given level of photosynthetically active radiation (PAR), increasing the CO_2 level to 1,000 ppm will increase the photosynthesis by about 50% over ambient CO_2 levels.

Carbon dioxide enters into the plant through the stomatal openings by the process of diffusion. Stomata are specialized cells located mainly on the underside of the leaves in the epidermal layer. The cells open and close allowing gas exchange to occur.

The concentration of CO_2 outside the leaf strongly influences the rate of CO_2 uptake by the plant. The higher the CO_2 concentration outside the leaf, the greater the uptake of CO_2 by the plant. Light levels, leaf and ambient air temperatures, relative humidity, water stress and the CO_2 and oxygen (O_2) concentration in the air and the leaf, are many of the key factors that determine the opening and closing of the stomata.



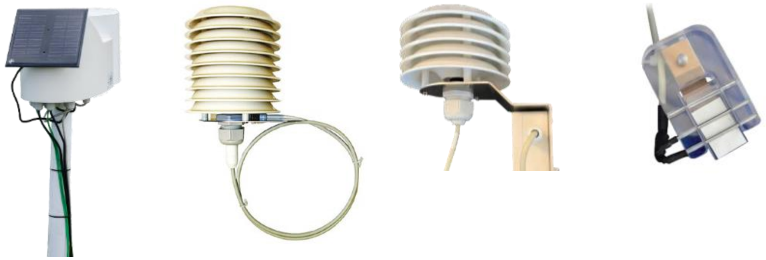
METOS® Monitoring Tools

METOS® Devices Dedicated to Greenhouses

	LoRa devices	µMETOS	iMETOS 3.3	RadioNode	iSCOUT®	CropVIEW®
Air temperature	✓	✓	✓	✓	✓	✓
Relative humidity	✓	✓	✓		✓	✓
Dew Point	✓	✓	✓		✓	✓
CO_2 level	Soon	Soon	✓	✓		
VPD	✓	✓	✓		✓	✓
Global radiation		✓	✓			
Photosynthetically Active Radiation			✓			
Leaf Temperature			✓			
Leaf Wetness	✓	✓	✓		✓	✓
Soil moisture	✓	✓	✓	✓		
Soil Temperature	✓	✓	✓	✓		
Pests & Crop monitoring					✓	✓

Greenhouse – Recommended Sensors

µMETOS + air temperature and relative humidity + CO_2 sensor + leaf wetness



iMETOS 3.3 IMT300

- Air temperature
- Relative humidity
- Rainfall
- Leaf wetness
- Global radiation
- Windspeed
- Disease modeling
- ET_0 calculation
- Forecasting

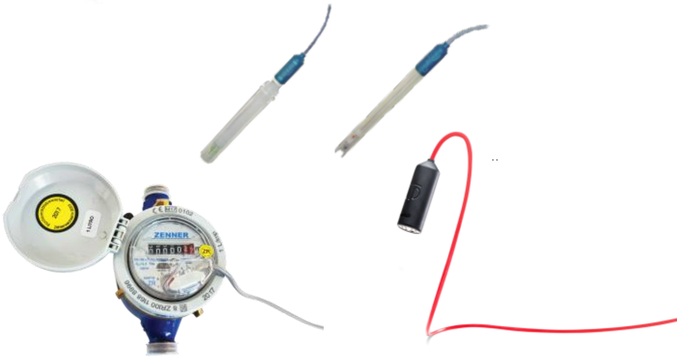
Soil temperature sensor, PAR sensor and leaf temperature

Soil moisture add-ons

- 2x PI54-D soil moisture sensor
- 1x Watermark
- 1x Drill&Drop probe

Irrigation management add-ons

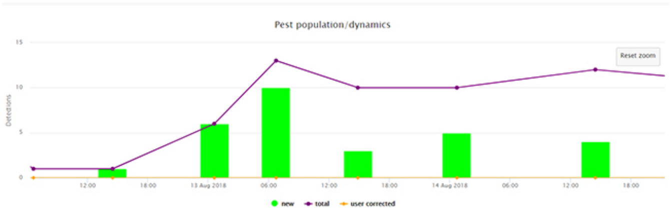
- Flow meter
- pH sensor
- EC sensor
- Water temperature



Greenhouse Crop & Pests Monitoring

iSCOUT® COLOR TRAP

Designed and developed to monitor sticky traps of different colors. The device comes with high resolution camera and a holder for a sticky plate.



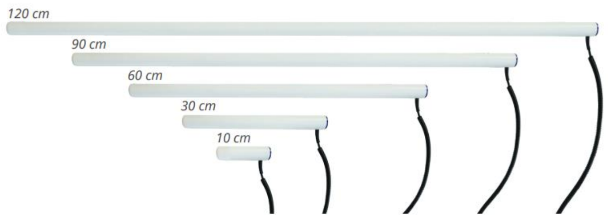
CropVIEW®

Optical high-resolution camera system is installed in the greenhouse to remotely monitor plants. All of the photos and data from computer vision software is displayed online, on a web portal **FieldClimate**.

Soil Moisture Sensors

Volumetric sensors

The **PI54-D** determines volumetric water content (VWC) by measuring the dielectric constant of the soil using capacitance technology and soil temperature.



Sentek Drill & Drop probe provides the user with great flexibility for precision monitoring of temperature, water and salinity (Triscan). Available in lengths: 10, 30, 60, 90 and 120 cm with sensors fixed at every 10 cm increment.

The Aquacheck sub-surface soil moisture probe offers capacitance based soil moisture and temperature measurements along the vertical soil profile.

Tensiometric sensors

The **Watermark** Sensor consists of two concentric electrodes buried in a special reference matrix material that is held in place by a synthetic membrane. The matrix material has been selected to reflect the maximum change of electrical resistance over the growth range of crop production.

The **IRROMETER TENSIOMETER** measures soil water tension (or suction). This value represents the energy a plant's root system uses to draw water from the soil. Available in different lengths: 15 cm, 30 cm, 45 cm, 60 cm and 90 cm.

METOS® Irrigation Management

How is Soil Moisture Measured?

There are different approaches to define, represent and measure how much water there is in the soil:

- **Volumetric water content**, VWC or θ ➔ measured by **volumetric sensors**
- **Soil water potential** or **tension** or **suction** ➔ measured by **tensiometric sensors**

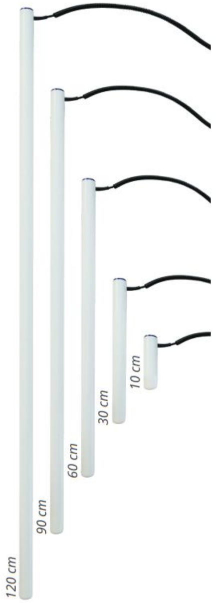
VWC vs Tensiometric Soil Moisture?

- **Volumetric water content (VWC) -** is a numerical measure of soil moisture. It is simply the ratio of water volume to soil volume. Measured by **volumetric sensors**

- **Soil water tension (SWT)** is the force necessary for plant roots to extract water from the soil. Soil water tension reflects the soil moisture status. The higher the tension, the drier the soil. Measured by **tensiometric sensors**

SENTEK DRILL & DROP TRISCAN PROBE

- VWC
- Soil temperature
- Soil salinity (VIC)
- Length: 30, 60, 90, 120, 150 cm
- One sensor every 10 cm
- Rapid connector
- Cable protection



WATERMARK (IRROMETER)

- Soil water tension

Soil Moisture Sensors

Two different approaches giving two different types of information:

Volumetric water content VWC [%] sensors :

- Instantaneous answer to rainfall or irrigation
- How fast the water moves along the soil profile
- Which portion of the root zone is wet
- Find out if any water is lost due to deep percolation
- How much and how often we have to irrigate

Tensiometric sensors [kPa, cbar]:

- How the water is available for the plant
- How much force the plant root system has to apply to extract water from the soil
- Direct indication of stress conditions
- Possibility to define a priori easy management rules

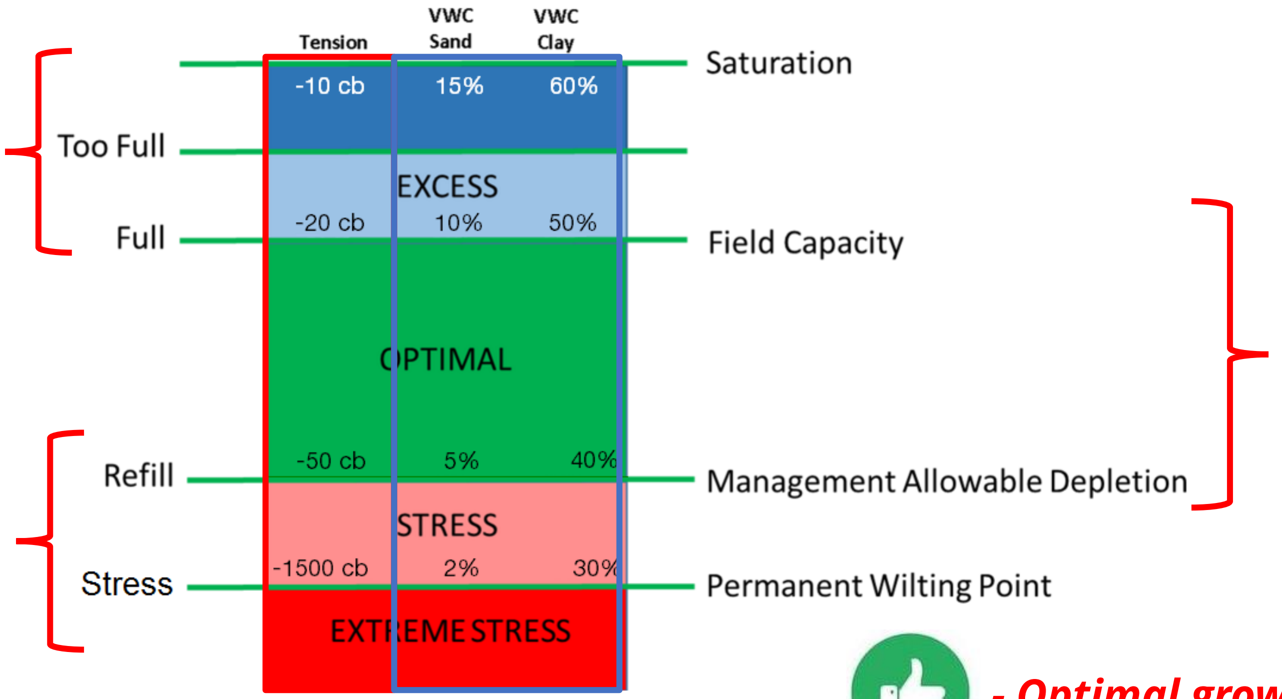
Soil Moisture Data Meaning

- **Field Capacity** is the amount of soil moisture or water content held in the soil after excess water has drained away and the rate of downward movement has decreased
- **Saturation** - If all soil pores are filled with water the soil is said to be saturated
- **Permanent Wilting Point** **(PWP)** - The soil water content at the stage where the plant dies, is called permanent wilting point

Management Line

Physical Meaning

- Plant stress
- High risk of disease
- Violation of nutrition in the soil



- Risk free
- No stress
- Optimal plant growth

- Plant stress
- Will reduce soil nutrient intake

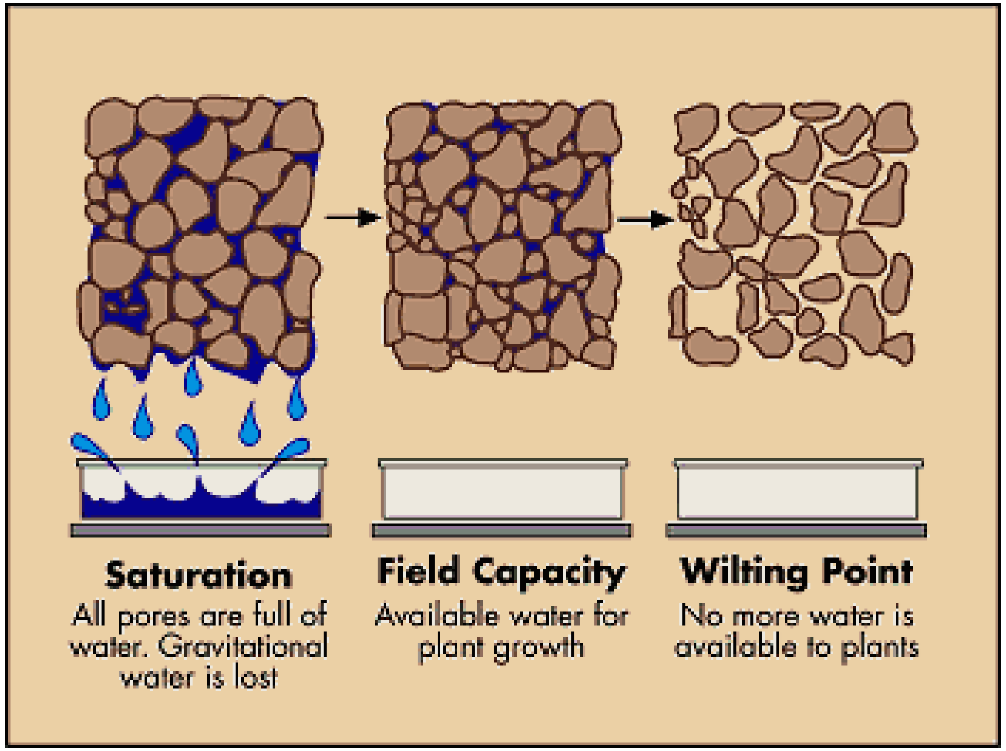
- Yield losses

- Optimal growth conditions

Refill Point and Field Capacity

Refill point is the point when you will irrigate again.

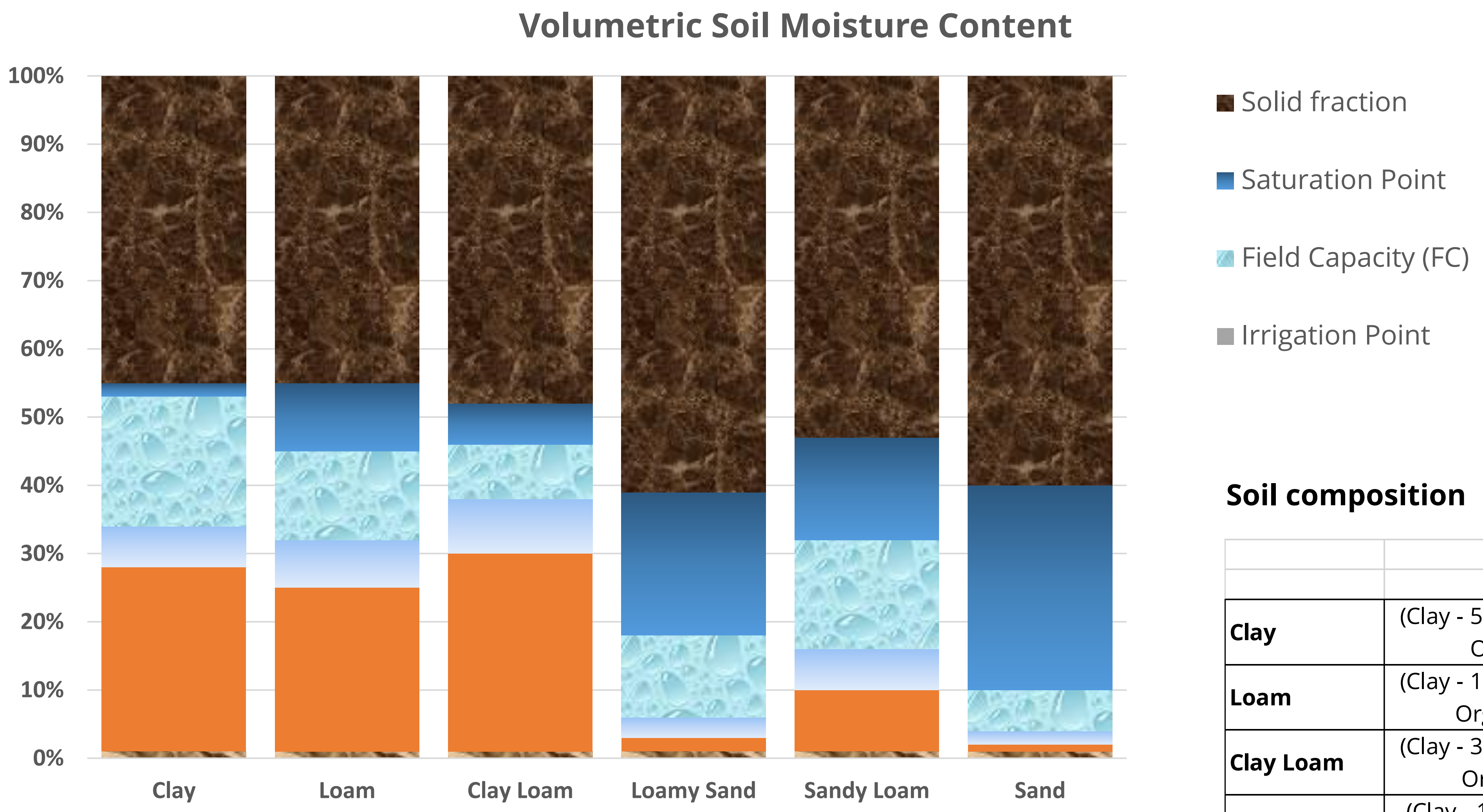
Field capacity is the point where the soil starts holding the water against gravity.



Warning - Field Capacity:

- it depends on the type of soil : texture, bulk density, root density and organic matter, gravels presence (structure of the soil), salinity…);
- it is a range;
- it depends on initial conditions (during the year and during the season, different for different phenological stages);
- could be recommended change it during the season or for different seasons/years.

Soil Moisture vs Soil texture

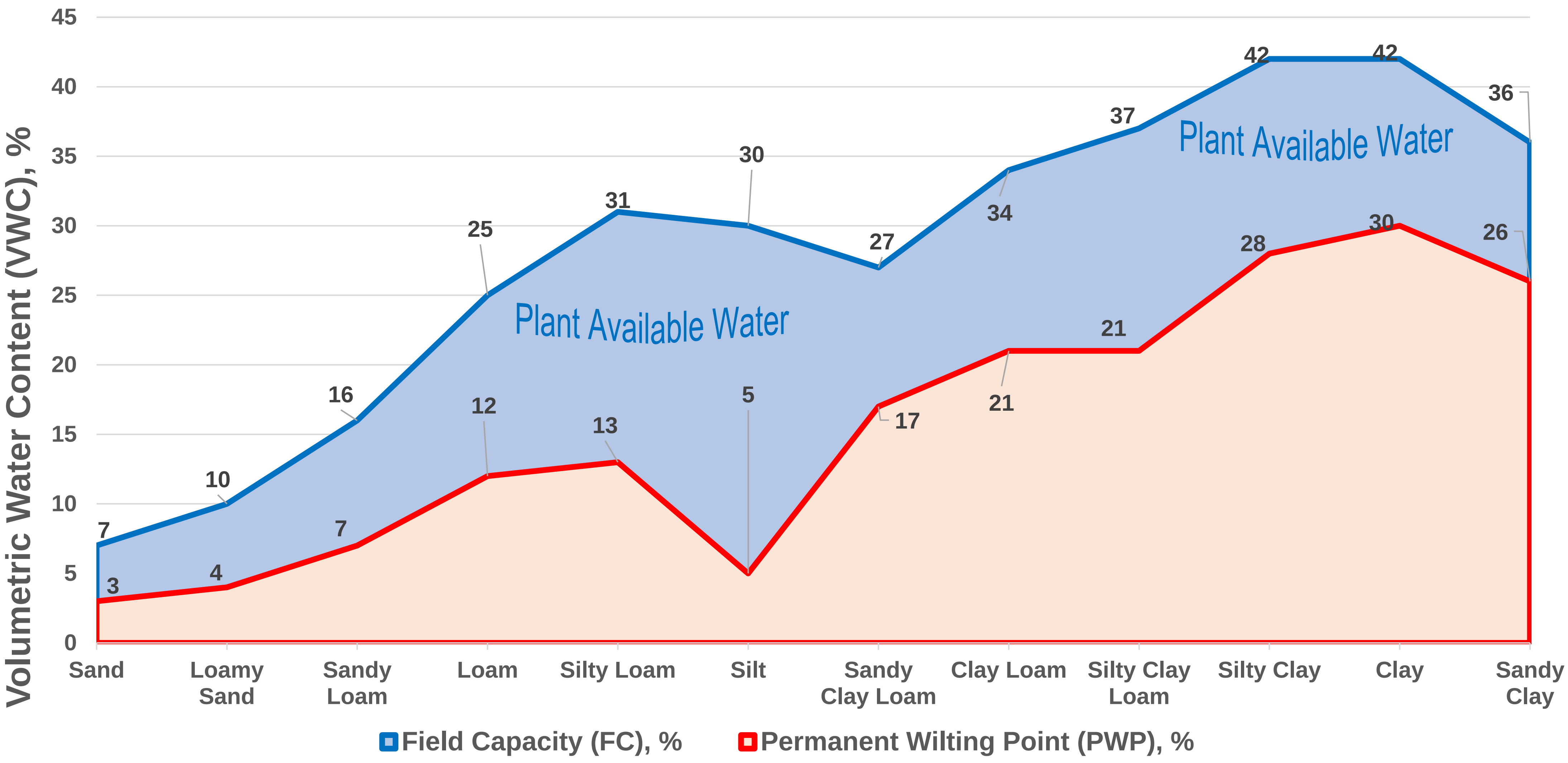


Please note!!! Soil water holding capacity depends on your particular soil texture.

Soil composition

Clay	(Clay - 55%, Silt - 35%, Sand - 10%, Organic Matter - 0%)
Loam	(Clay - 19%, Silt - 41%, Sand - 40%, Organic Matter - 12,1%)
Clay Loam	(Clay - 32%, Silt - 28%, Sand - 40%, Organic Matter - 0,2%)
Loamy Sand	(Clay - 12%, Silt - 6%, Sand - 82%, Organic Matter - 0,6%)

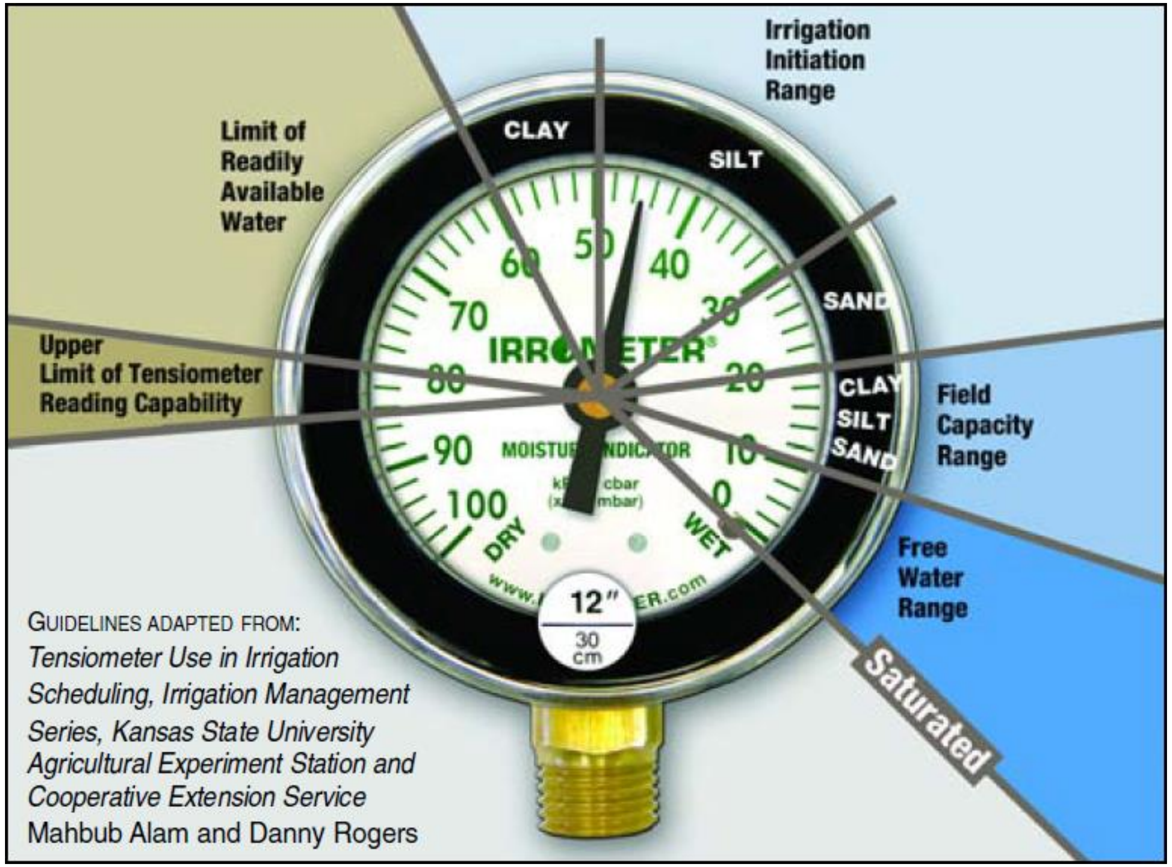
SOIL TYPE
Texture-based estimates of FC & PWP



Soil Water Tension

Soil water tension is the amount of energy holding water in soil, or (putting it differently) the **amount of energy needed to pull water out of soil**. You'll also see soil water tension called soil water potential, matric potential, and various other names. It's a measure of how tightly water is bound to soil surfaces or how hard the plant roots need to work to extract water.

Soil water tension is usually **measured in centibars (cb)**, where a centibar is 1/100th of a bar and a bar is equivalent to about one atmosphere of pressure. However, you may **also** see it measured **in kilopascals (kPa)**. Moreover, soil water tension numbers are usually shown as negative but are sometimes given as positive numbers. So, just make sure you know how the scale works and whether a high or low number means dry soil.

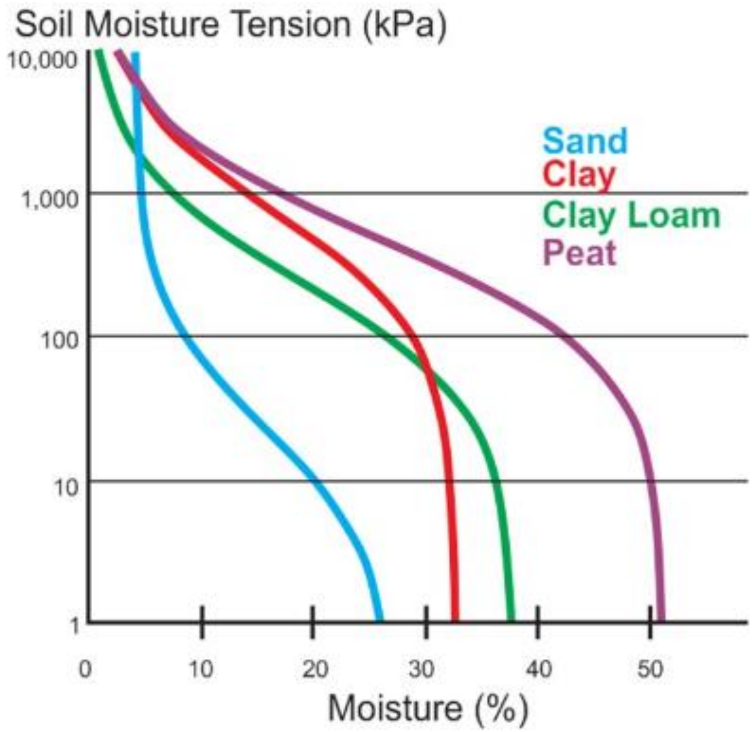


Soil Water Tension

Many irrigators prefer to measure soil moisture tension (instead of VWC) because it relates directly to plant well-being, “comfort,” and stress. When you measure soil water tension, you’re measuring the various forces at work in soil that make it hard or easy for plant roots to extract water. As an analogy, think about the work it takes to drink a thick milkshake through a straw. Water always moves from higher to lower water tension (or potential), so soil water tension measurements allow predictions of water movement.

Irrigation Guidelines Based on Centibar Readings

Reading, cb	Interpretation
0 - 10	Saturated soil
10 - 20	Most soils are at Field Capacity (FC)
30 - 40	Typical range of irrigation in many coarse soils
40 - 60	Typical range of irrigation in many medium soils
70 - 90	Typical range of irrigation in heavy clay soils
> 100	Crop water stress in most soils



Irrigation Control

GREENHOUSE

SENSORS TO USE

- Watermark

Examples of Suggested Refill Point Range Using Tensiometers

Crop Tension (kPa)		Crop Tension (kPa)	
Celery ** 20-30	Cucumber (pickles) *45	Parsnip * 70	Tomato ** 60-70
Chinese Cabbage 25	Carrot * 45	Strawberry *** 10-20	Turnip * 45
Broccoli * 25	Eggplant * 45	Peas * 70	Radish * 25
Corn ** 50-80	Lettuce * 34	Strawberry **** 20-30	Cauliflower * 34
Brussels Sprouts *25	Rutabagas * 45	Peppers * 45	Celery * 25
Cabbage * 34	Lettuce ** 40-50	Tomato * 45	

References

* Sanders, D.C., 1997. Vegetable Crop Irrigation. Horticulture Information Leaflet 33-E, North Carolina Cooperative Extension Service, NC State University.

** Gratton, S.R. and J. Oster, 1992. Water Quality Guidelines for trees and vines. Drought Tip 92-38, CA Dept. of Water Res., LAWR Dept.-Univ of CA, USDA Drought Response Office and USDA Soil Conservation Service.

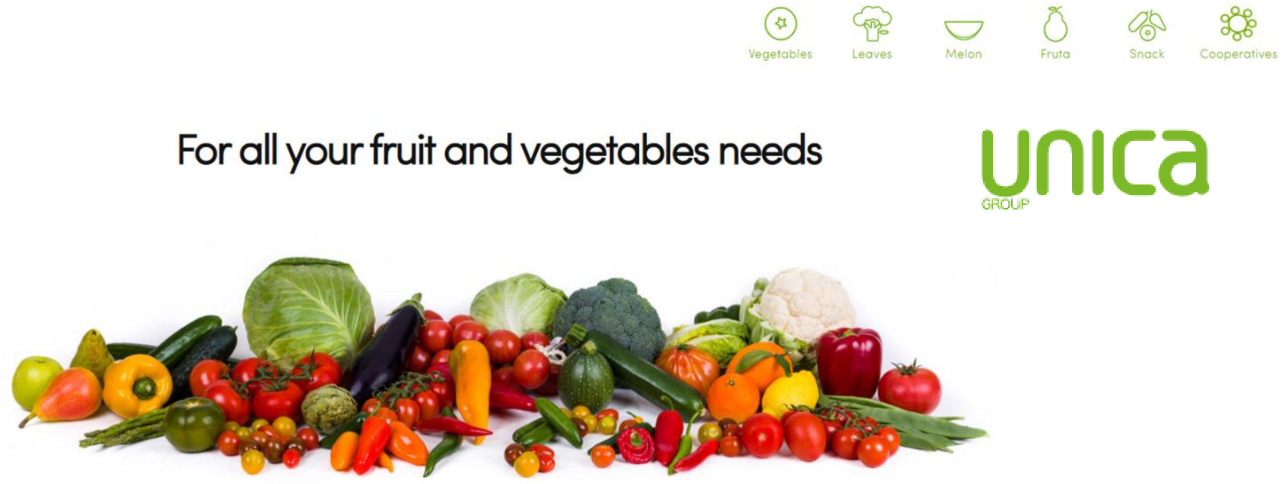
*** Himelrick, D.G., L.M. Curtis, and T.W. Tyson, 1999. Commercial Strawberries. Publication ANR-662, Alabama.

**** Strawberry Plasticulture Guide for North Carolina, The Southern Region Small Fruit Center, NCSU Centennial Campus, Raleigh, NC.

METOS® Hydroponic Scale

Overview

- Hydroponics production is increasing worldwide.
- Our partners and distributors have consistently shown interest in the specific configuration for decision support system to attend to the needs of hydroponic farm managers.
- Pessl Instruments is currently working on finding a global approach to solutions for hydroponics, based on solutions from our current portfolio, instead of supplying partial solutions for specific projects.



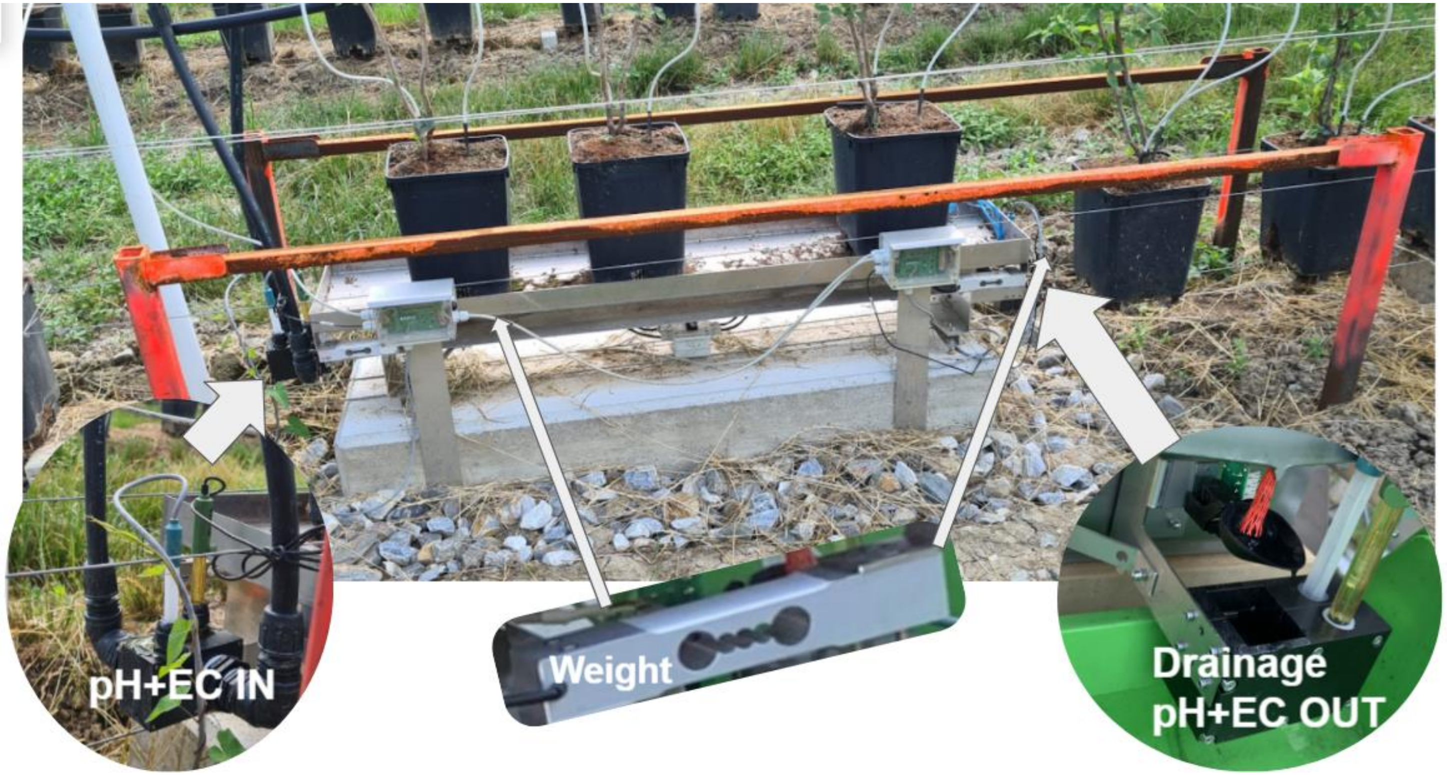
Features

- Control and optimize the plant’s root growth and increase your yield quantity and quality
- Stable production with high yield and quality, an adequate irrigation control is essential
- Wireless, cloud-based irrigation monitoring system
- Cost effective: save significantly on water and fertilizer costs

The System

The compact monitoring system includes:

- EC & pH inlet and outlet
- Drainage to measure the amount of outlet solution
- High-quality scale to measure the weight of the substrate
- Quantity and timing of the irrigation
- 2 minutes logging interval




Líder Fresh


Líder Fresh

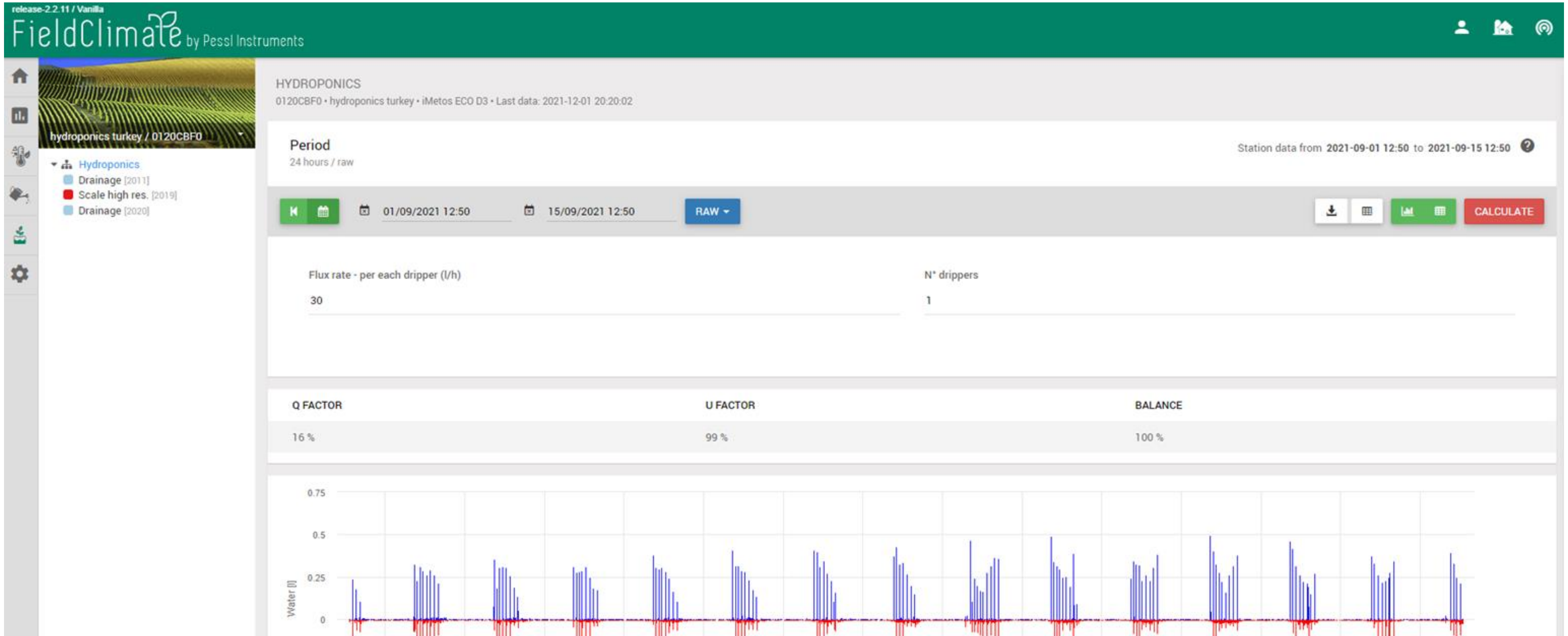
Monitor the Drainage

- Monitor the amount of drainage, timing, uniformity and EC/pH throughout the day
- For example, if the timing of irrigation is not precise, there could be excessive drainage in the morning or afternoon when it is not required.

The Software - FieldClimate

The image shows an example of how water balance can be defined from the changes in weight and the measurement of the drainage in our FieldClimate platform. With drainage counter in good conditions the model gives:

- the drainage quotient (Q factor) to inform about the drainage blocking or excessive rate
- the uptake quotient (U factor) is related with the plant uptake and plant growth
- balance which validates the system data



METOS®

Pessl INSTRUMENTS

PESSL Instruments GmbH

Werksweg 107

8160 Weiz

Tel.: +43 (0) 3172 5521

Fax: +43 (0) 3172 5521 23

email: sales@metos.at

www.metos.at