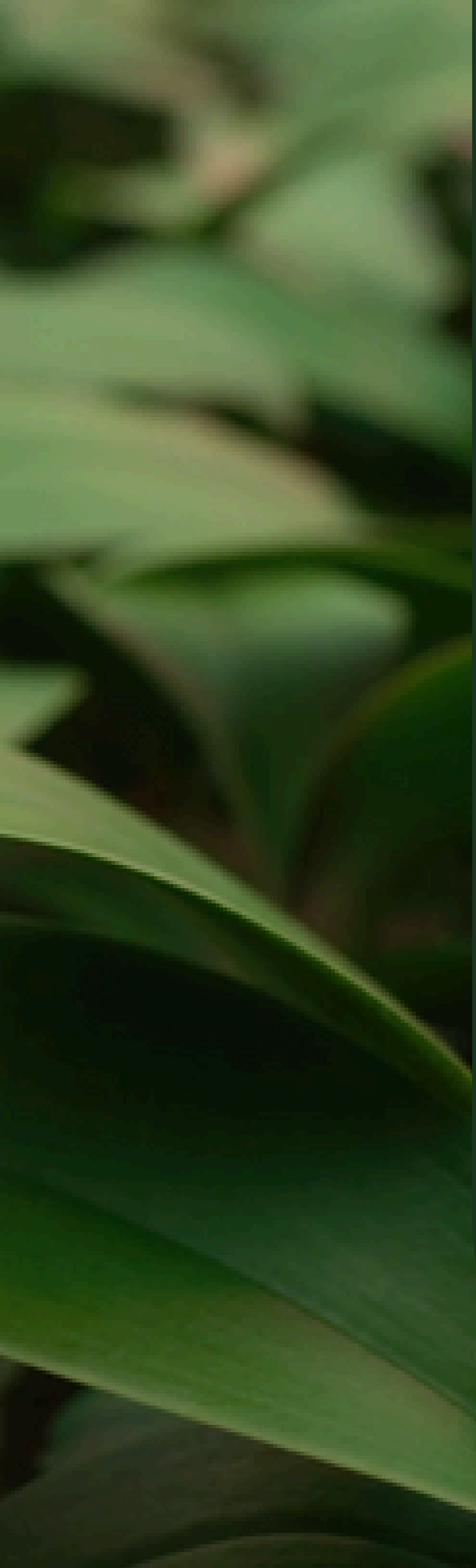
Whitepaper

How to spot invisible plant stress

Your crop may look healthy, but looks can be deceiving. By recognizing invisible stress early, you can prevent losses in both quality and yield. With the insights and real-life examples in this whitepaper, you'll know exactly where and when to take action.



Foreword

Dear Reader,

In the greenhouse everything often seems fine: the light, temperature and humidity all appear to be within range. The plants look healthy and there are no obvious signs of trouble. Yet there can be factors holding your plants back from reaching their full potential. Stress can quietly build up without you noticing it, and by the time it becomes visible, it's often too late.

In this whitepaper, we take a closer look at what we call invisible stress: what happens when light, moisture or evaporation are just slightly off balance. More importantly, we show you how to catch those early warning signs. Inside, you'll find practical insights, real-life examples and, above all, a way to respond faster and smarter to what your plants are trying to tell you.

By understanding your crops better, you can manage more effectively, act sooner, and ultimately get more out of every growth phase. Technology like MyLedgnd supports you in this, not as a goal in itself, but as an extension of your cultivation expertise.

With Legendary greetings,
Team MyLedgnd

Myledgnd

Contents

1 Introduction

Invisible stress is a complex and often underestimated problem in the greenhouse. In this whitepaper, we help you pinpoint three main causes: light stress, transpiration stress and moisture stress from condensation.

At first glance, plants in a greenhouse seem to grow under ideal conditions: there is enough light, warmth, water and nutrients. Yet even in this seemingly perfect climate, invisible stress can occur. These stress factors are often not immediately noticeable to the naked eye, but they can have a significant impact on photosynthesis, growth, resilience and ultimately the yield of your crop.

In this whitepaper, we cover three common forms of greenhouse stress:

- Light stress
- Transpiration stress
- Moisture stress (from condensation)

Every type of stress affects plants differently and requires a tailored approach. Understanding the differences helps you respond more effectively and prevent damage before it happens.

The chapters are clearly structured with the following layout:

1. A definition of the stress type
2. The consequences for the crop
3. Physical signs of the stress in the plant
4. A practical example of stress, explained using data from MyLedgnd

By the end of this whitepaper, you will have the tools to recognize stress signals early.

Give your crop a voice...

Data visualisation MyLedgnd

PAR 1
7.00
µmolm²/s
8/5/2025 8:00 PM

TEMP
17.80 °c
8/5/2025 8:00 PM

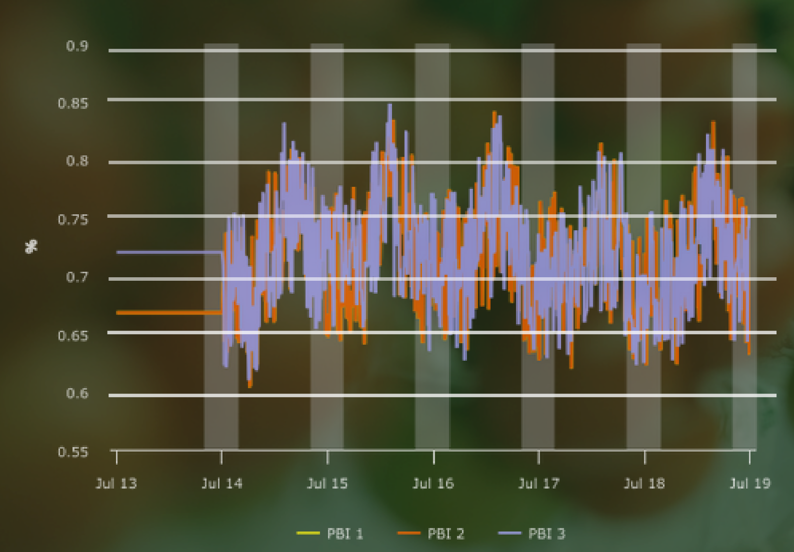
VPD
0.50 kPa
8/5/2025 8:00 PM

PBI
0.67 mV
8/5/2025 8:00 PM

PAR 3
7.00
µmolm²/s
8/5/2025 8:00 PM

TEMP 3
17.80 °c
8/5/2025 8:00 PM

Plant Balance Index (PBI)



Plant Day Activity

2 Light stress

What is light stress?

Light stress occurs when plants face physiological strain or disruption due to too much light, prolonged exposure, or sudden changes in lighting conditions. This type of stress often develops quietly and isn't immediately visible, but it can affect growth, health, and overall plant performance if left unchecked.

Impact of light stress

1. Reduced photosynthesis efficiency

- Too much light can cause plants to close their stomata, limiting CO_2 intake and slowing down photosynthesis.
- Even when climate conditions improve, the photosynthetic system may remain damaged.

2. Decline in quality

- Prolonged exposure to excessive light can stunt growth or cause abnormal development.
- Fruits may become misshapen or show reduced quality.

3. Leaf overheating

- Excess light causes stomata to close, reducing transpiration and causing leaf temperature to rise.
- This lowers photosynthesis efficiency and energy production, disrupting leaf processes and ultimately leading to poorer leaf quality.

4. Disruption of physiological processes

- Light affects hormone balance and flowering induction.
- Stress can upset the balance between growth hormones, such as auxin and cytokinin.

Did you know...

...plants, when exposed to too much light, convert the excess energy into heat to protect themselves?

This is called ‘non-photochemical quenching’ and prevents lasting cel damage.

Physical signs of light stress

Light stress leaves traces not only in the data but also on the plants themselves.
When light intensity and temperature rise too high, visible changes start to appear in leaves, flowers, and fruits. Below, you will find the main physical signs to help you recognize light stress in the greenhouse.

Burn spots on leaves or fruits

What you see
Brown or black, dry spots on the top leaves or on fruits exposed to direct light.

What it means
The amount of light, often combined with high greenhouse temperatures, causes physical cell damage that becomes visible over time.

Bleaching or discoloration of leaves

What you see
Leaves turn lighter green, yellow, or even almost white (bleaching).

What it means
Chlorophyll is broken down by excessive light and/or heat, which can reduce the plant's photosynthesis capacity.

Dry or burnt edges on the leaves

What you see
The edges of the leaves turn brown, dry, and may curl up.

What it means
Extreme moisture loss combined with high leaf temperatures can cause cell walls to break down.

Early leaf shedding

What you see
The plant sheds leaves, usually from the top or from the most exposed parts.

What it means
Damaged leaves are dropped because excessive light speeds up the aging process.

Reduced flower or fruit development

What you see
Flower buds drop off or flowers stay small. Fruits may remain undersized or become misshapen.

What it means
The plant redirects its energy toward recovery instead of production.

Practical Example Light Stress

Situation
Crop: Tomato
Season: Late summer
Growth stage: Generative

Used sensor
Sendot Photosynthesis Efficiency sensor with PAR at leaf level

MyLedgnd graphs
- Light deviation
- Photosynthesis

Data from MyLedgnd

Lichtafwijking: the percentage deviation of the Electron Transport Rate (ETR). It shows how efficiently the plant can convert light into energy, which is then used to produce sugars.
Target value: above 30% indicates stress, while values below 20% point to insufficient light.

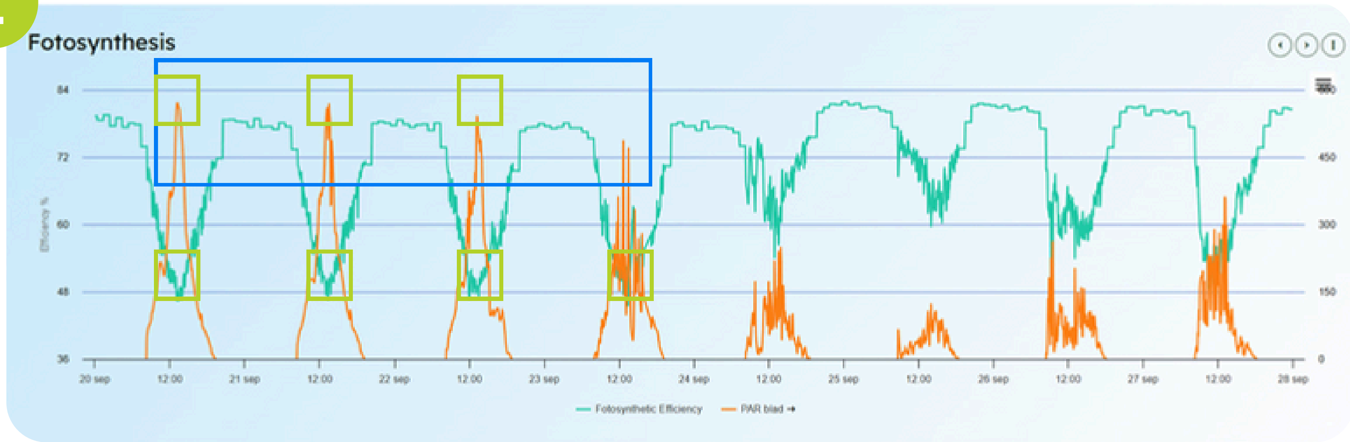
Photosynthesis efficiency: shows how well a plant can convert incoming light into sugars, the energy source it needs for growth.
Target value: varies per crop and conditions. In this case (tomato greenhouse), the target during rest at night is 82%.

PAR at leaf level: The amount of usable light (400–700 nm) that reaches the leaf for photosynthesis.

In *Graph 1: Photosynthesis*, the PAR values (**Blue**) show that between September 20 and 23 the crop was exposed to high light intensities for extended periods, sometimes reaching nearly 600 μmol/m²/s.
During the day, photosynthesis efficiency (**Green**) dropped to 48%, and at night it did not rise above 77%.

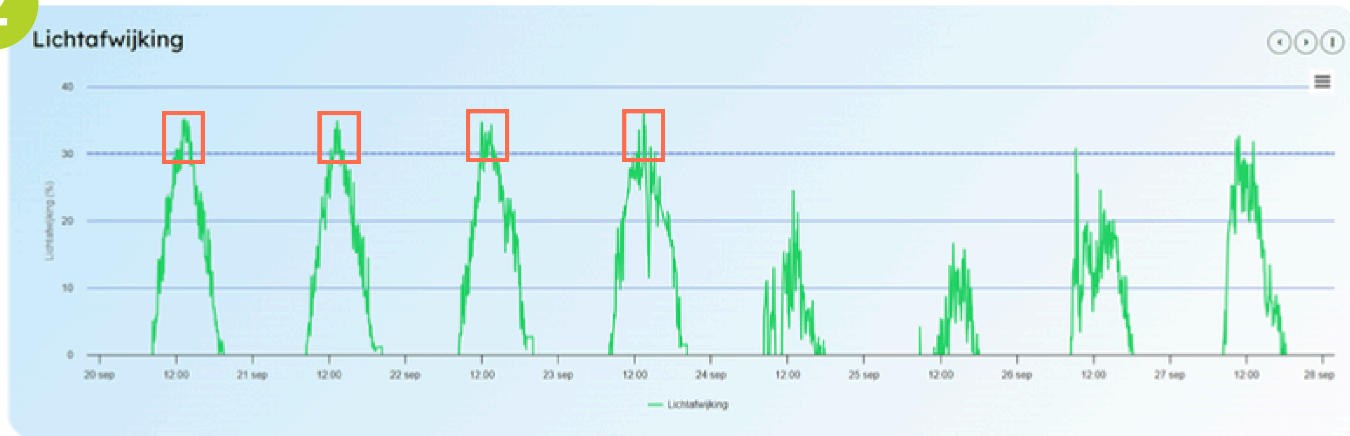
The target value for photosynthesis efficiency at rest is 82%. This situation therefore indicates potential light stress. To confirm this, we can look at the *Light Deviation* graph (*Graph 2*).

1



In *Graph 2: Light Deviation*, we can see that the light deviation (**Orange**) on the same days, from September 20 to 23, consistently stayed above the target value of 30%. This confirms our earlier assumption that the crop did indeed experience light stress during that period.

2



In this situation, the plant was no longer able to make optimal use of the light. On September 24, when light levels dropped below 200 μmol/m²/s, the plant was able to recover. We can see the photosynthesis efficiency moving back toward the target value of 82%.

Conclusion

This example clearly shows that excessive light intensity leads to light stress. By taking timely action, for instance by temporarily shading during peak light, crop damage can be prevented. Smart light management, based on real-time plant data, ensures that the plant makes the most of the light without becoming overloaded.

3 Transpiration stress

What is transpiration stress?

Transpiration stress occurs when a plant loses more water through evaporation (transpiration) than it can take up through its roots. This often happens under high VPD (vapor pressure deficit), low humidity, high temperatures, or strong sunlight. The plant's water balance becomes disrupted, leading to internal tensions and stress responses that ultimately affect growth and development.

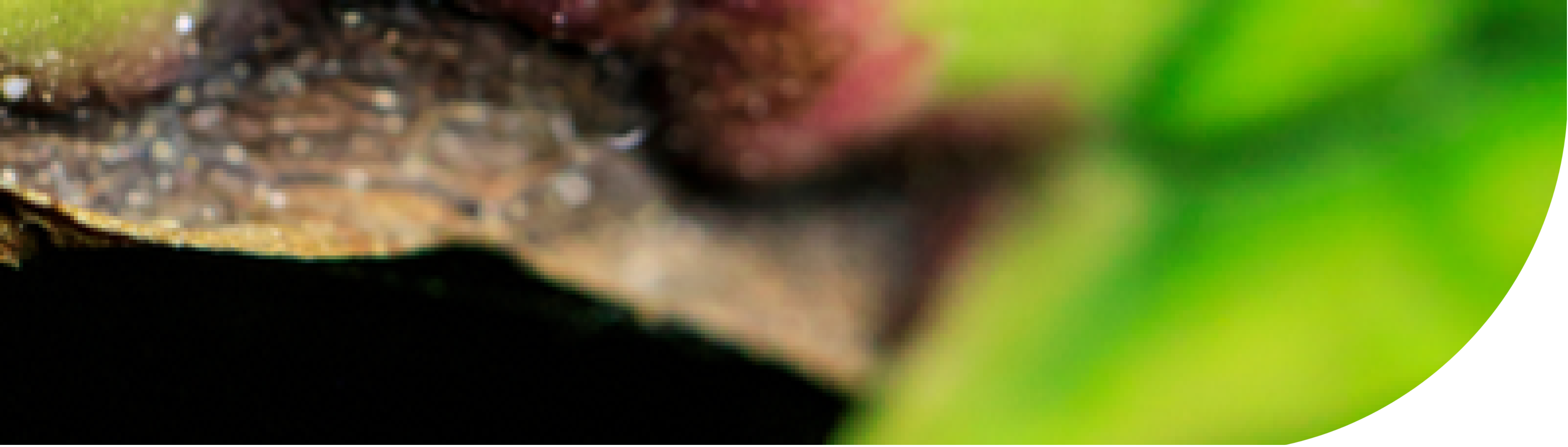
Impact of transpiration stress

1. Closure of the stomata

- Under high evaporation pressure, the plant closes its stomata to reduce water loss.
- This limits CO_2 intake and slows down photosynthesis.

2. Reduced photosynthesis efficiency

- Closed stomata decrease the amount of CO_2 available to the plant.
- Photosynthesis efficiency decreases, resulting in lower energy production for growth.



3. Limited nutrient uptake

- When water uptake from the roots is reduced, fewer nutrients become available.
- Nutrient deficiencies can lead to visible deficiency symptoms and a drop in crop quality.

4. Cell damage from negative pressure

- During prolonged stress, tensions build up in the plant's cell tissues.
- This can cause cell wall damage and the death of leaf or flower tissue.

5. Disrupted water and growth balance

- The plant falls out of balance: too little water for growth, too much energy spent on survival.
- This leads to slowed cell division and elongation, resulting in reduced growth.

Did you know…

…that when evaporation pressure is too high, plants close their stomata as a protective mechanism to conserve water?

Physical signs of transpiration stress

What starts as an internal stress reaction becomes visible on the plant if corrective action is not taken in time. When a plant loses more water through evaporation than it can absorb, visible stress signals appear over time. The physical signs below help you recognize evaporation stress.

Weak, hanging leaves

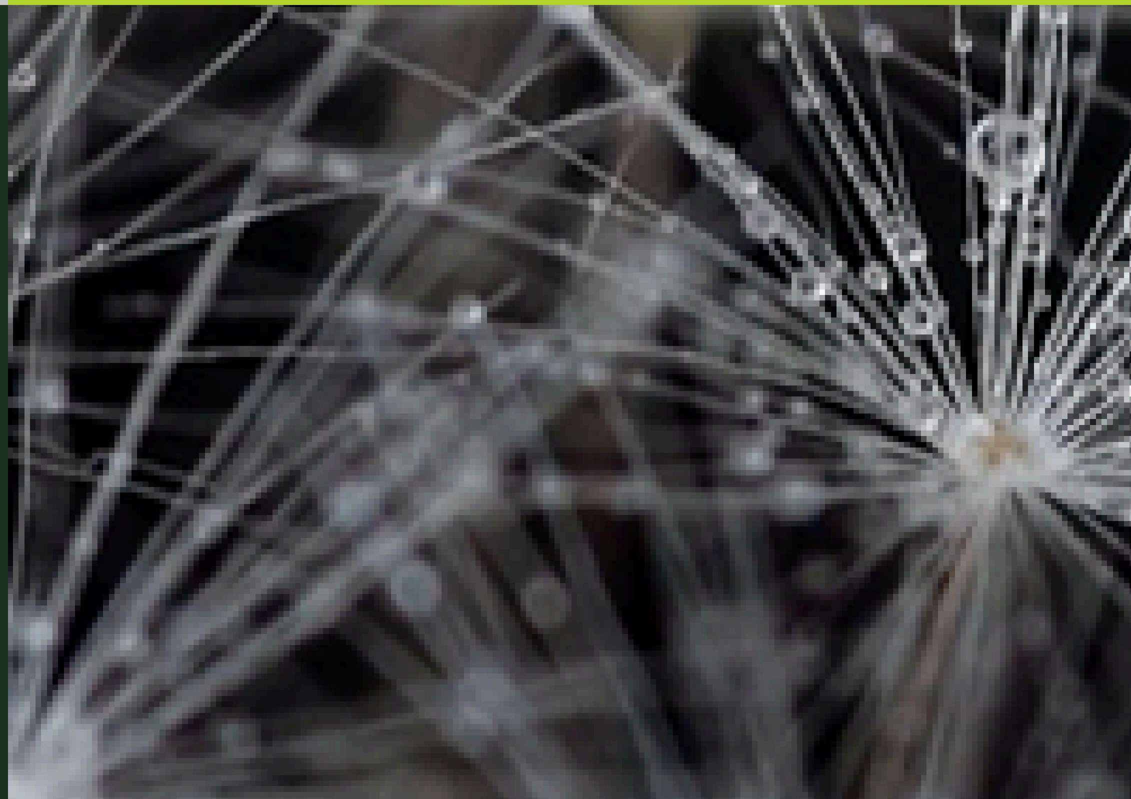
What you see
Leaves appear limp, especially during the warmest hours of the day.

What it means
The water pressure inside the cells is too low to keep the leaves firm.

Curled or rolled leaves

What you see
Leaf edges curl inward or roll into a tube shape.

What it means
A self-protection response to reduce further water loss through the leaf surface.



Dry or brittle leaf edges

What you see
The leaf edges become dry and brittle, sometimes burning, curling, or even tearing.

What it means
Local dehydration occurs under prolonged high vapor pressure deficit. During extreme transpiration, water is mainly drawn to older leaves that lose a lot of moisture, leaving young leaves or growth points with insufficient calcium.

Disruption of flower development or fruit set

What you see
Flower buds drop or flowers fail to open properly. Fruits remain small.

What it means
The plant redirects its energy toward recovery instead of production.

Leaf discoloration from nutrient deficiency

What you see
Leaves turn yellow (depending on the deficiency). Later, edges or parts of the leaf may die off.

What it means
Reduced water uptake also limits nutrient absorption or can cause an imbalance in ion uptake.

Practical Example Transpiration Stress

Situation
Crop: Cucumber
Season: Spring
Growth stage: Generative

Sensors used
- Sendot Photosynthesis Efficiency
- Aranet Temperature/Humidity Sensor (T/RH)

Consulted MyLedgnd graph
Photosynthesis and Vapor Pressure Deficit (VPD) (single graph)

Consulted MyLedgnd data
- *Photosynthesis efficiency*: shows how well a plant transforms sunlight into sugars, providing the energy it needs to grow.
- *Vapor Pressure Deficit (VPD)*: indicates how dry the air is and how much evaporation the leaf surface experience.

Target photosynthesis efficiency

The target value for photosynthesis efficiency, i.e., how effectively a plant converts sunlight into energy, varies depending on the crop and conditions. In this example, the target value at night ranges between 80% and 82%.

The ideal VPD balance

For most crops, the ideal VPD (Vapor Pressure Deficit) balance is usually between 0.8 and 1.2 kPa. A too-high VPD (> 2.0 kPa) causes the plant to lose water too quickly, while a too-low VPD (< 0.2 kPa) indicates the air is saturated with moisture, and the plant barely transpires. Both situations are critical and lead to evaporation stress. In response, the stomata may partially or fully close to reduce water loss, which in turn limits CO_2 uptake and lowers photosynthesis efficiency.

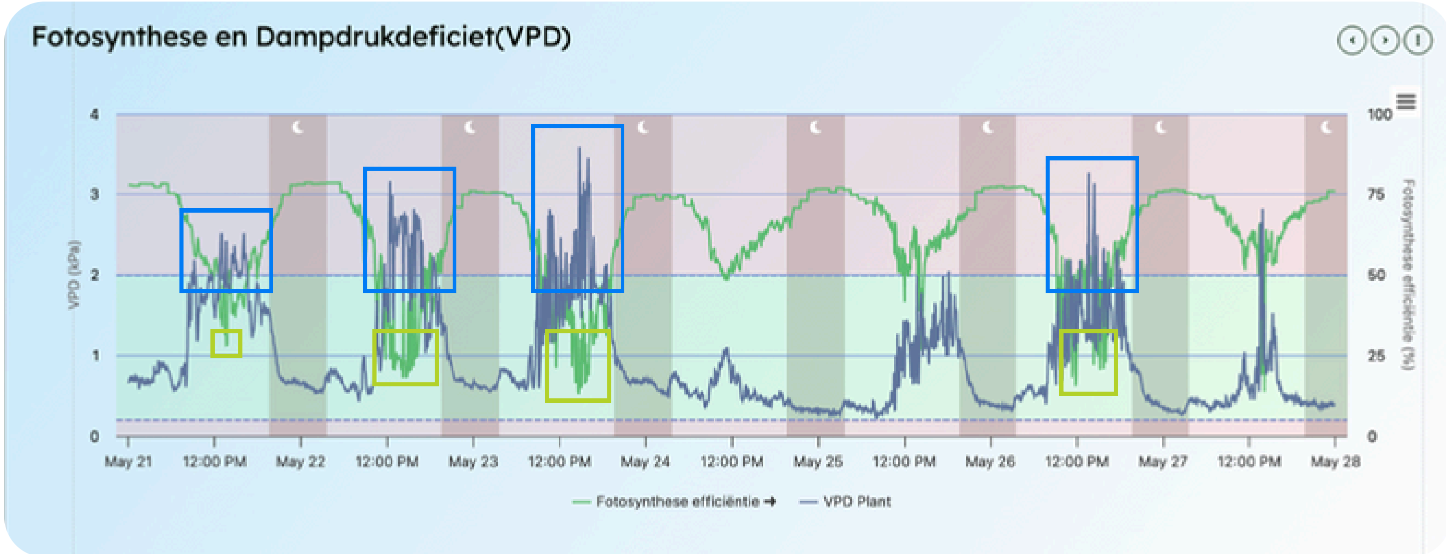
Analysis of the Graph

The MyLedgnd graph for Photosynthesis and Vapor Pressure Deficit (VPD) shows that on May 21, 22, 23, and 26, the VPD values (**Blue**) rose above 2.0 kPa. On these days, photosynthesis efficiency (**Green**) also dropped below 30%, indicating severe stress.

The high VPD suggests the plants were under pressure to lose water through transpiration. In response, the stomata partially closed, limiting CO_2 uptake and directly causing a decline in photosynthesis.

The night of May 23–24 stands out: previous nights saw photosynthesis efficiency recover to approximately 79–80%, but this time it only reached 75–76%.

This suggests persistent stress or potential lasting harm to the photosynthetic system.



Conclusion

This practical example demonstrates that high vapor pressure due to light and temperature can lead to stress and reduced growth. By monitoring VPD and photosynthesis efficiency in real time with MyLedgnd, growers can intervene promptly with climate management measures to minimize damage.

4 Moisture stress

Caused by condensation on the leaf surface

What is moisture stress?

Moisture stress from condensation occurs when the leaf temperature drops below the dew point of the surrounding air, often due to high relative humidity and low leaf temperature. This creates a thin film of water on the leaf, which hinders the gas exchange of the stomata. The stomata function less effectively, and the water layer provides an ideal breeding ground for fungi and bacteria.

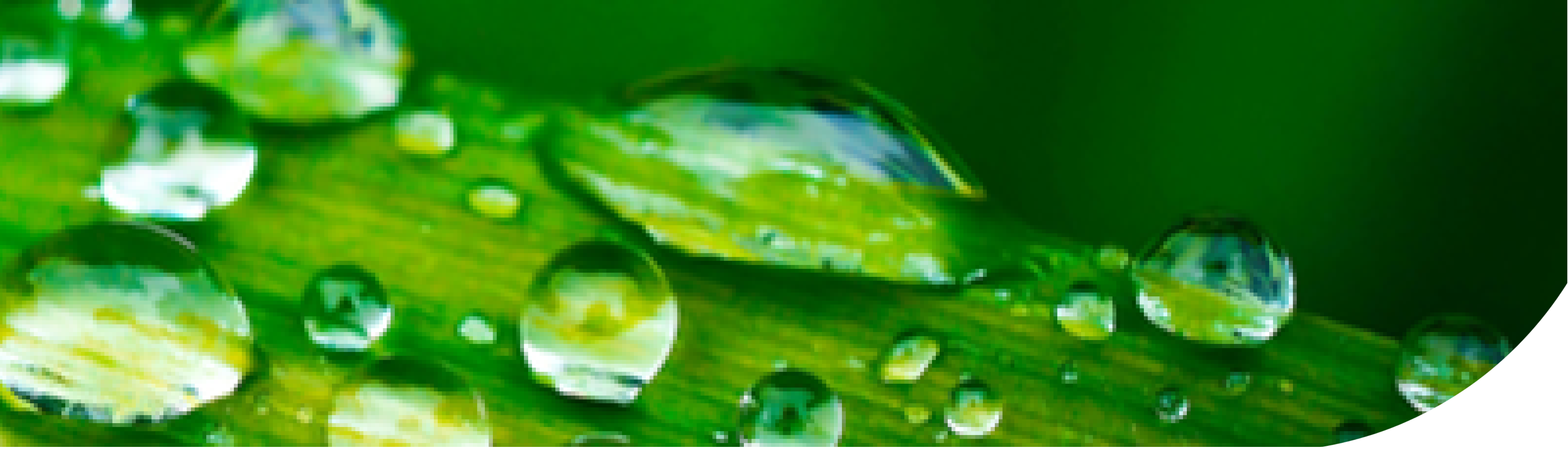
Impact of moisture stress

1. Disrupted transpiration and nutrient transport

- When the leaf surface is wet, the plant struggles to transpire.
- As a result, the transport of water and nutrients from the roots slows down.

2. Increased risk of disease

- Condensation on the leaf surface creates a humid microclimate.
- This increases the risk of infections such as Botrytis (grey mould) and powdery mildew.



3. Disruption of gas exchange through stomata

- Condensation can partially block or completely close stomata.
- If this occurs during the day, CO_2 uptake is reduced, limiting photosynthesis..

4. Decline in photosynthetic efficiency

- When stomata close, intercellular CO_2 concentration (Ci) drops, reducing internal CO_2 availability.
- This lower Ci limits part of the photosynthetic process, preventing the plant from using all available light for sugar production.

Did you know...

...leaf condensation can occur with less than a 1.5°C difference between leaf temperature and the dew point?

Even a small difference (<0) almost always causes condensation on the leaf, creating a risk of fungal growth and reduced gas exchange.

Physical signs of moisture stress

Moisture stress from condensation is deceptive: it starts as an invisible layer on the leaf but quickly leads to visible damage.
From fungal growth to premature leaf aging, the symptoms vary depending on duration, location, and leaf temperature. Below, we present five examples of how moisture stress can physically show up in a crop.

Dull or shiny spots on the leaf

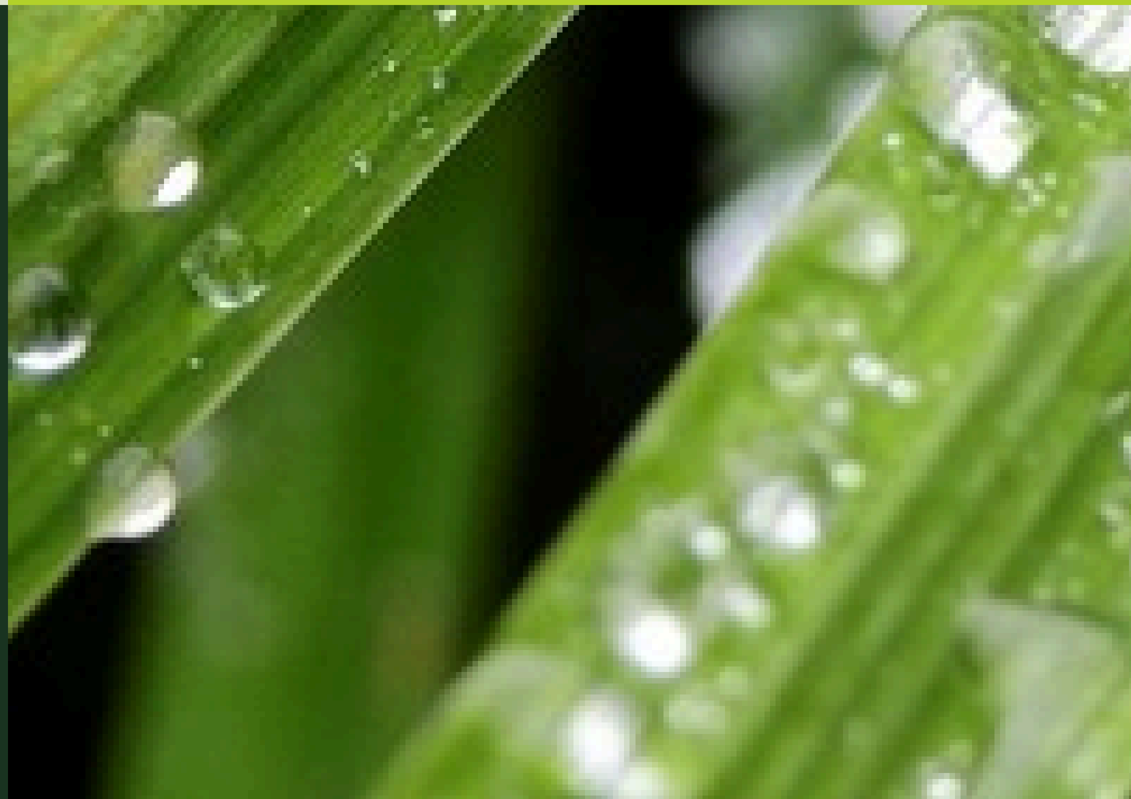
What you see
A visible water film or droplets on the leaf, especially in the morning.

What it means
Condensation caused by high humidity and cold surfaces.

Leaf spots or fungal growth

What you see
Brown, gray, or white spots on areas where moisture has lingered for a long time.

What it means
Early signs of infection by Botrytis or other fungi.



Premature leaf aging

What you see
Leaf turning yellow or developing necrotic tissue.

What it means
Stress caused by reduced photosynthesis and increased disease pressure.

Poor opening of stomata

What you see
Reduced transpiration, visible in data such as low VPD values even when the crop looks healthy.

What it means
Stomata function is restricted by a water film, limiting gas exchange.

Uneven temperature distribution within the crop

What you see
Cooler leaf surfaces in moist areas, sometimes visible in IR measurements.

What it means
A water film on the leaf slows warming and reduces transpiration.

Practical Example Moisture Stress

Situation
Crop: Gerbera
Season: Mid-spring
Growth stage: Generative

Used sensors

- Aranet Leaf Temperature
- Aranet Temperature/Humidity (T/RH)

Consulted MyLedgnd graph
Leaf-dew point temperature

Consulted MyLedgnd data

- *Leaf temperature*: the actual temperature of the plant's leaf surface.
- *Dew point temperature*: the temperature at which the air becomes saturated with water vapor, causing it to condense into liquid water (dew).

Imbalance leaf and dew point temperature

Before looking at the data, it's important to understand when an imbalance arises between leaf temperature and dew point temperature, as this can trigger invisible plant stress.

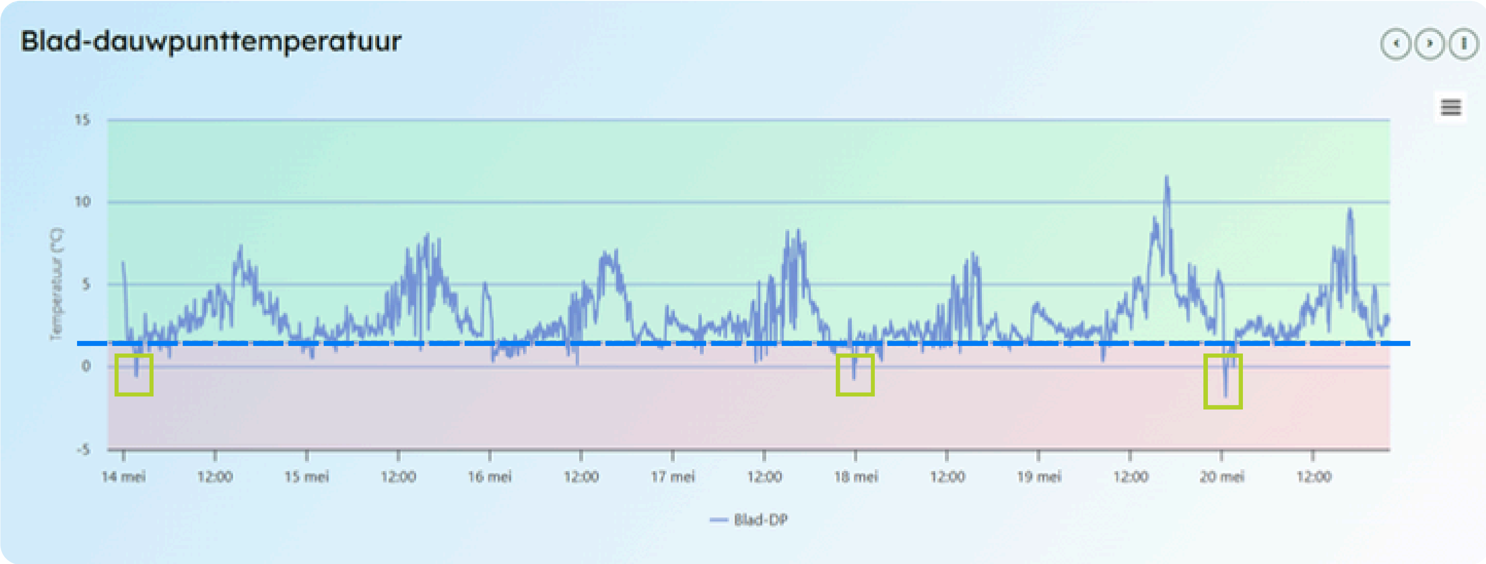
The general rule is as follows:
When the leaf temperature comes too close to the dew point, with less than 1.5 difference, there's already a risk of condensation forming on the leaf.

At a difference smaller than 0°C, condensation on the leaf surface is almost guaranteed.

- < 1.5°C difference = increased condensation risk
- < 0°C difference = condensation is already present

Graph analysis

The MyLedgnd Leaf–Dew Point graph shows that at several moments the temperature difference between the leaf and the dew point dropped below 1.5°C (**blue line**). This meant the crop was at increased risk of leaf condensation.



On the nights of May 14, 18, and 20 (**Green**), the temperature difference even fell below 0°C, indicating that condensation had actually formed on the leaves.

The data revealed that these risks occurred mainly during the nighttime hours. Thanks to real-time monitoring, timely actions could be taken, such as raising leaf temperature through heating, using screens at the right moment, or adjusting misting systems.

Conclusion

Condensation on leaves is a subtle form of moisture stress that often only becomes visible once the damage is already done. By closely monitoring the temperature difference between the leaf and the dew point, you can reduce this risk. It allows you to adjust climate settings in a timely and targeted way, preventing further moisture-related damage.

5 In conclusion

Invisible stress is deceptive. It infiltrates your greenhouse without visible signs, yet can have significant impacts on growth, yield, and plant health. This whitepaper has shown how light stress, transpiration stress, and water stress develop and how to detect them in time, not with the naked eye, but through data-driven insights from your own greenhouse

What you see

MyLedgnd collects data from sensors, plant feedback systems, climate computers, and other measuring tools, and translates it into clear graphs, dashboards, and soon even KPIs. At a glance, you can see whether your plants are performing optimally or under pressure. That means you can take targeted action without having to wait for physical damage to show up in your crop.

The benefits of working with MyLedgnd

- Insight into your plant's responses through real-time data
- Integration of sensors and other climate data in one place
- Clear visualizations for faster and more precise decision-making
- Support from plant physiologists for setup and interpretation

With MyLedgnd, you no longer rely on gut feeling, you work with hard plant data. The platform is intuitive, brand-independent, and designed for growers who want full control over their crop strategy. Whether you manage a single section or multiple locations, MyLedgnd gives you both the big picture and the details you need.

Give your crop a voice... Take the step toward data-driven growing with MyLedgnd today.

Non-binding sensor consultation

Do you want to detect invisible stress in your greenhouse before it causes damage? Schedule a free sensor consultation. Ramon and Niels will gladly help you explore the best sensors and data integrations for your specific situation.

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