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TABLE GRAPE CONFERENCE 2026
Connecting ideas | Cultivating success

Advanced covering materials

Engineered films for protected table grape and soft fruit production

Daios Plastics S.A. · Innovation & Business Development

5–6 August 2026 · Allée Bleue, Franschhoek

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UCDAVIS VITICULTURE & ENOLOGY

Our story

*Fifty years from commodity to specialty — from bags sold by the kilo to films engineered to be **the Solution** for one crop, one climate, one problem.*

1975

COMMODITY

Founded in Naoussa, Northern Greece, as a company making shopping bags.

1977

THE TECHNICAL TURN

First blown film line producing film with a variable thickness profile — and the first patented films for drying tobacco leaves and raisins.

1980

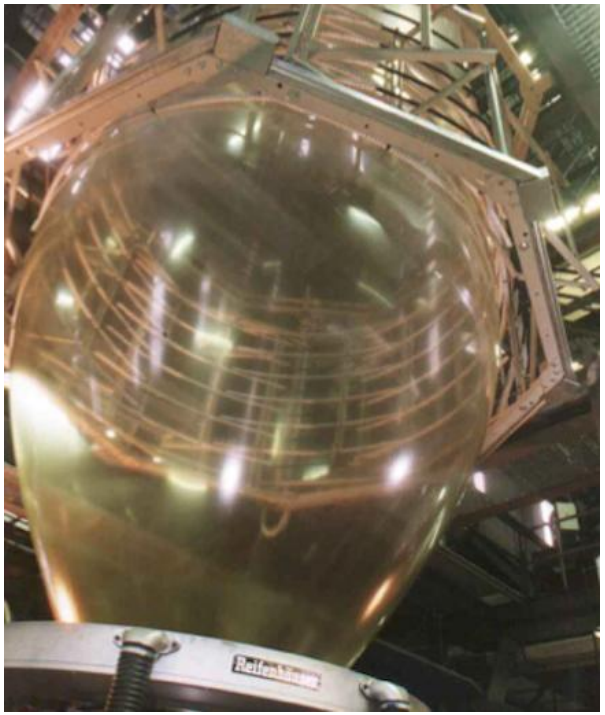
CROP-SPECIFIC

First product developed specifically for the cultivation of seedless grapes (Thomson seedless)

Today

SPECIALTY SOLUTIONS

55 EU and PCT patents, technical covers in 35 countries, 90% of production exported.



Blown film extrusion — the process behind the variable thickness profile.

What we make



Safe-D covers



Pocket films Dalin.



Mulch and cloches



Specialty Tunnel and greenhouse covers





The Science behind the cover

Polyethylene, solar radiation and what a technical film has to do

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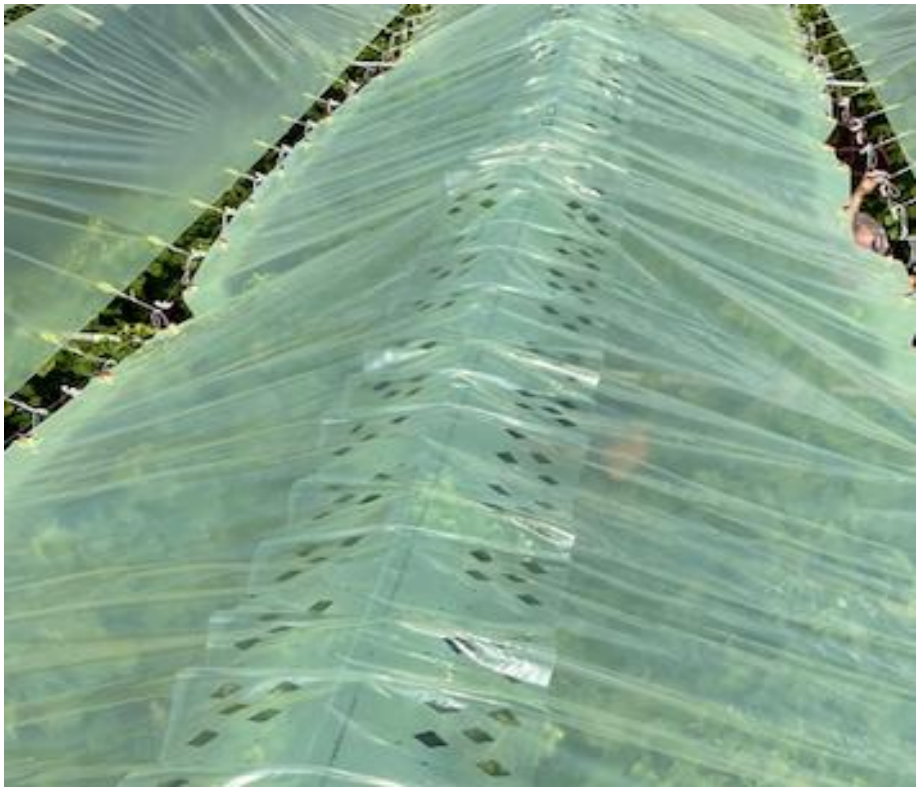
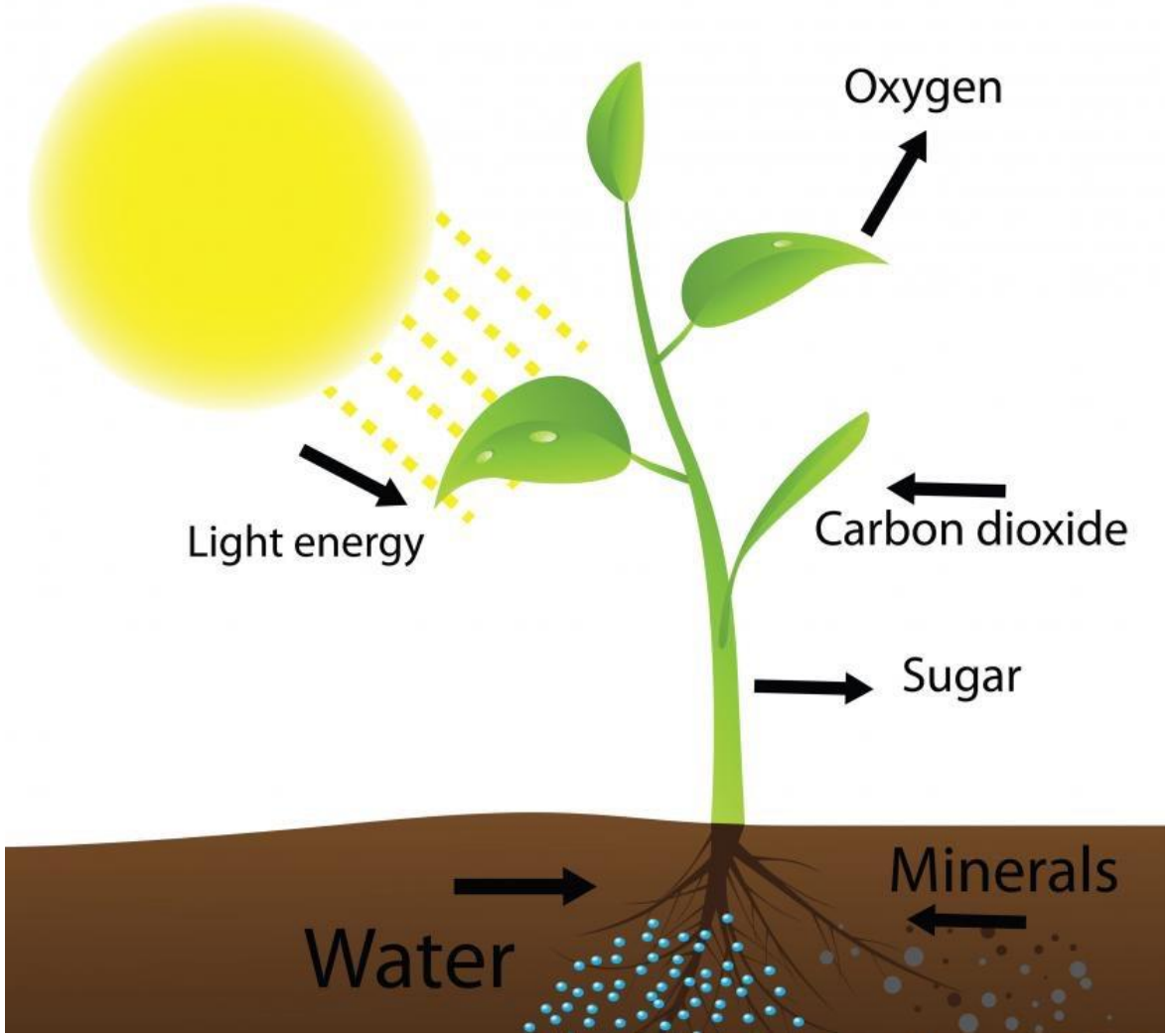
Benefits of protecting crops





- Protection from extreme weather: **rain, hail**, wind, direct radiation
- Extension of the season: advance or delay harvest
- Lower water consumption: reduced evapo-transpiration
- Lower use of phytosanitary products: fewer sprayings
- Higher yields: less stress on the plant

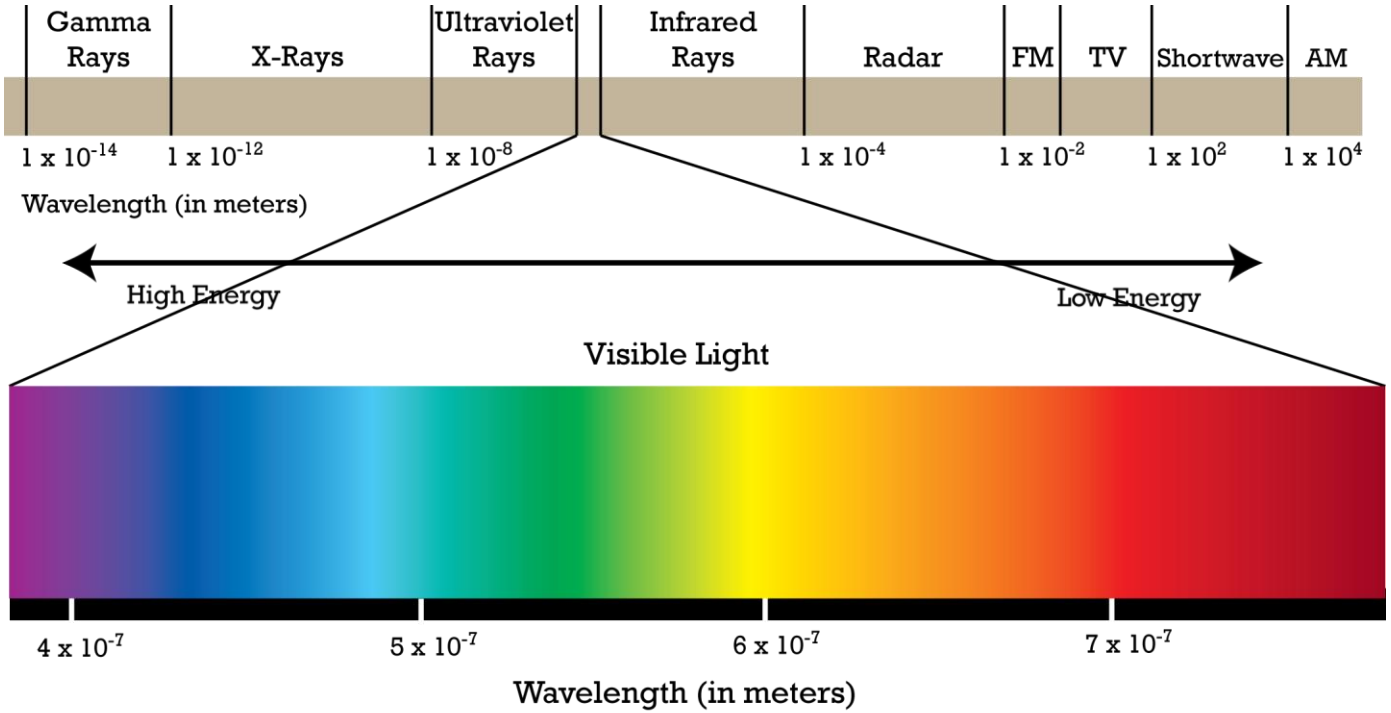
Light. The source of life for the plant



Light means photosynthesis.

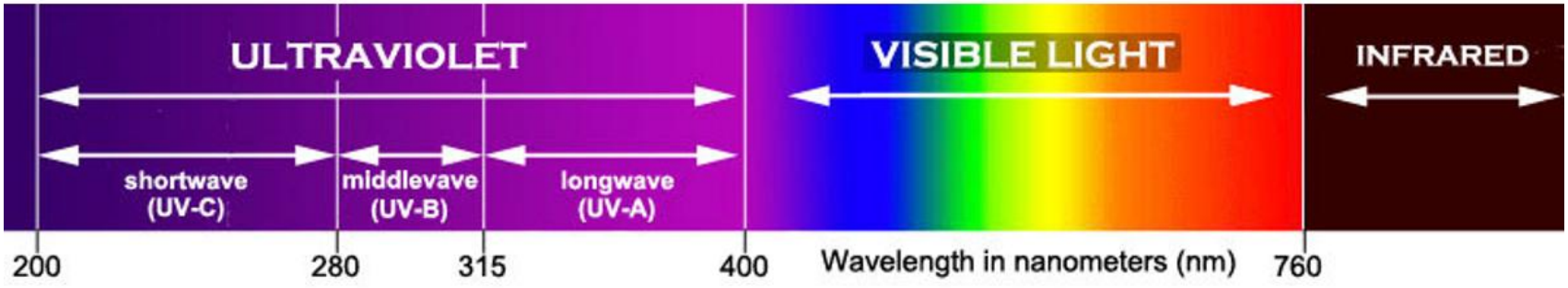
Safe-D is designed so that it provides **diffused light** that allows all leaves to receive an equal amount of light leading to equal photosynthetic levels

Light. The spectrum



- **85-90%** of the radiation goes through the film.
- The rest is reflected **(6-10%)**
- **4-5%** in absorbed and converted to heat.

Light. UVB and UVA

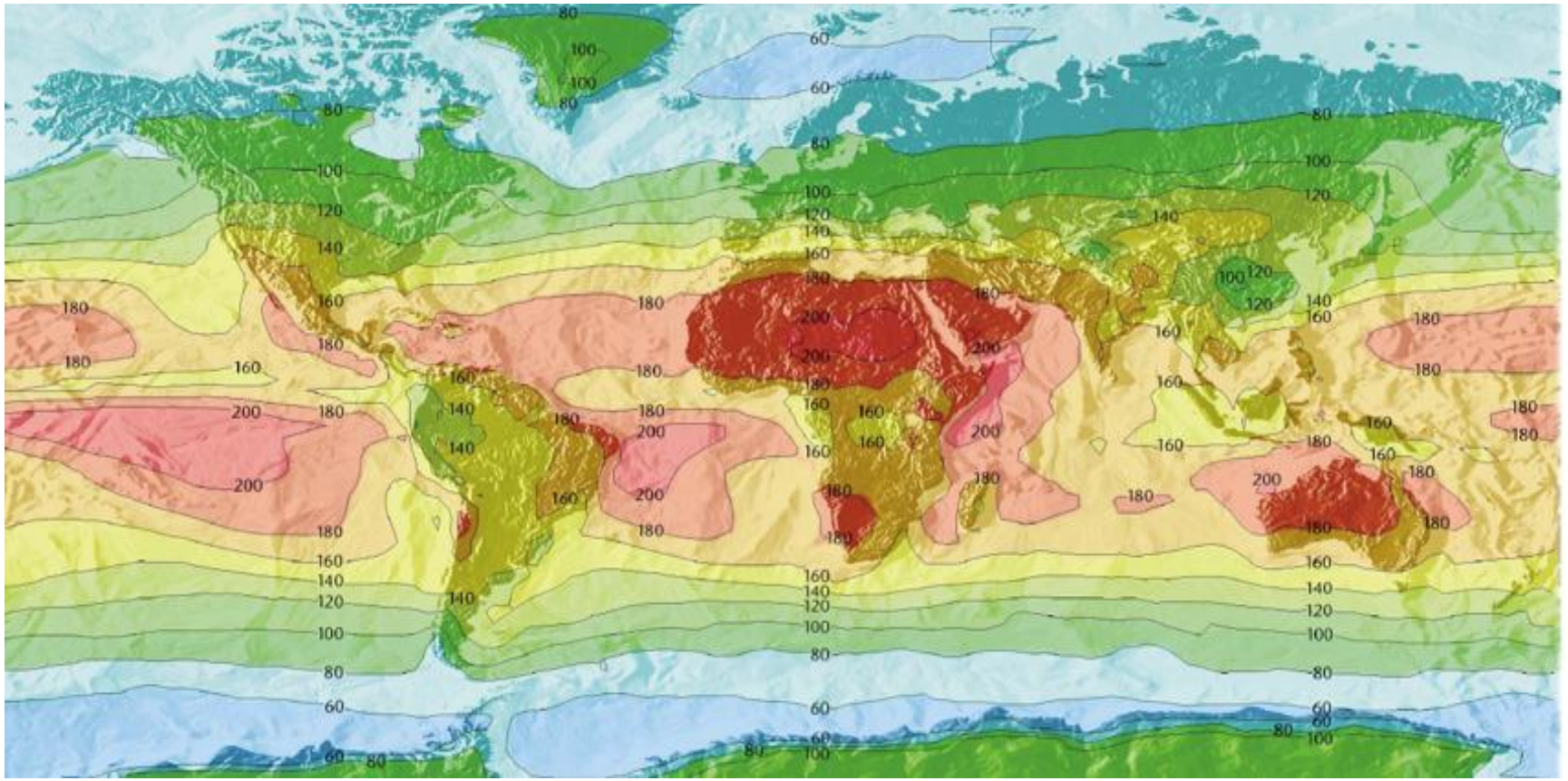


UV light 200-390nm. UVA and UVB facilitate the development of Antioxidants in the fruit.

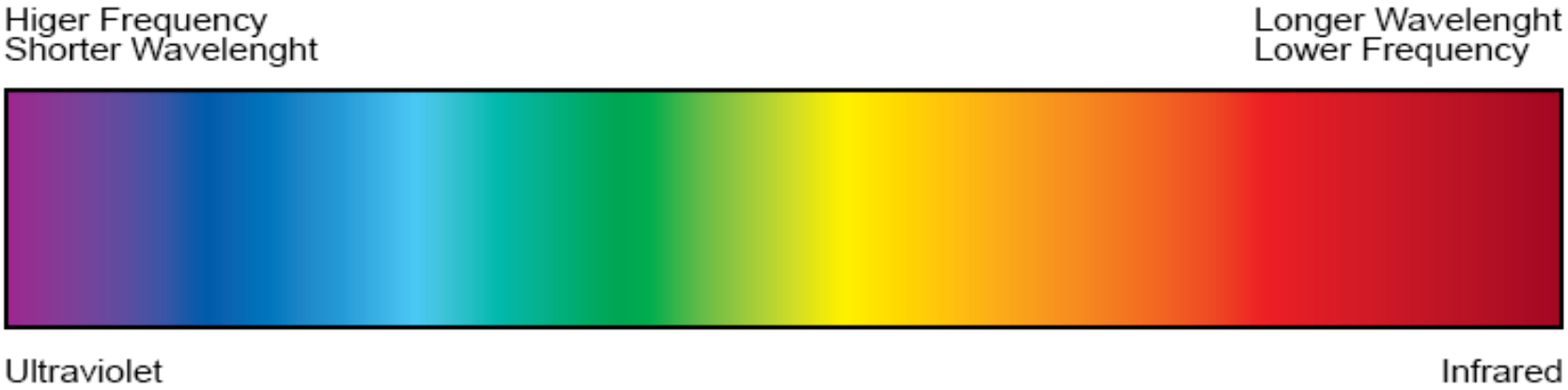
Solar radiation 200 – 2500 nm

Incoming solar radiation is the main source of energy that drives many of the Earth's physical and biological processes.

Solar radiation per latitude (KLy/year)



Light. PAR

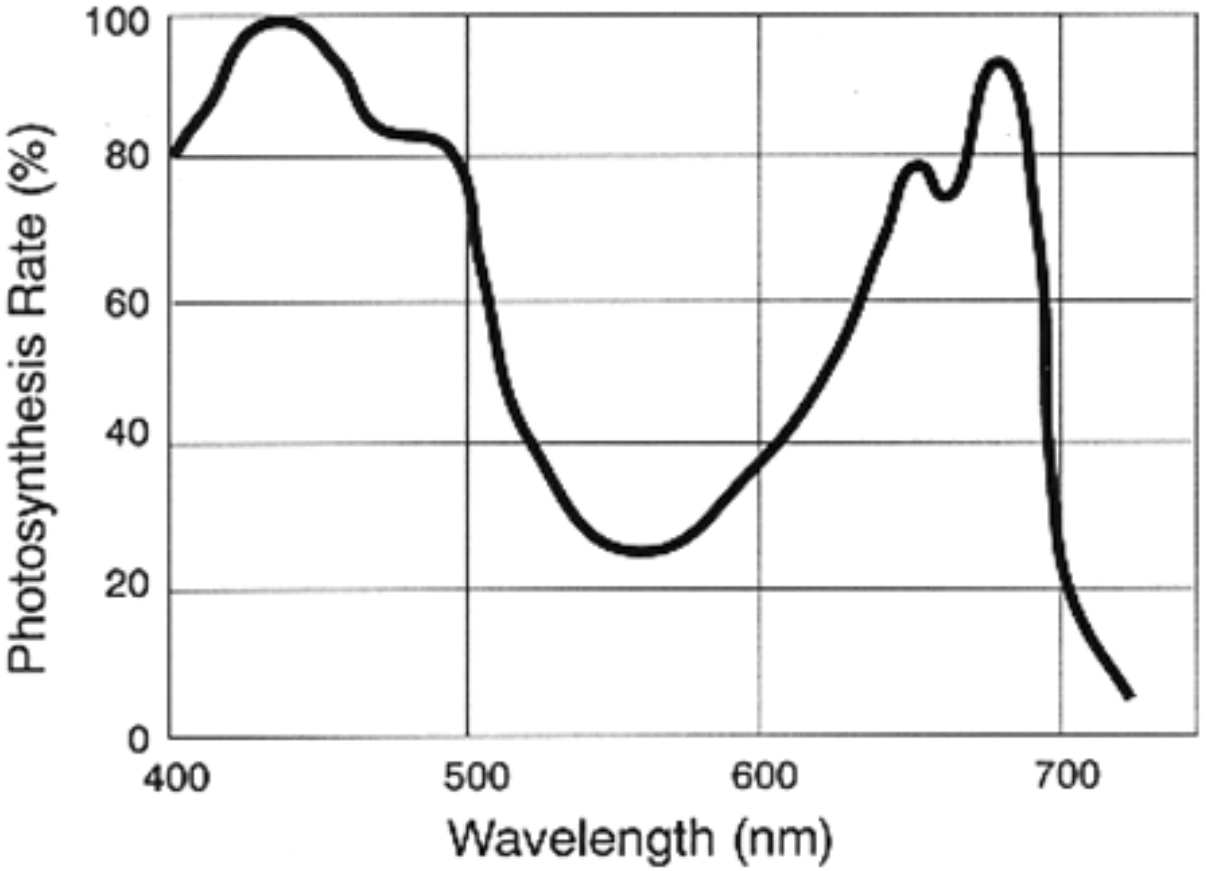


2. Visible light 390 -700nm. PAR (**P**hotosynthetically **A**ctive **R**adiation).

In Particular Red light activates Chlorophyll A, and Blue light activates Chlorophyll B.

Rest of the colours are absorbed by carotenes, xanthophylls and anthocyanines.

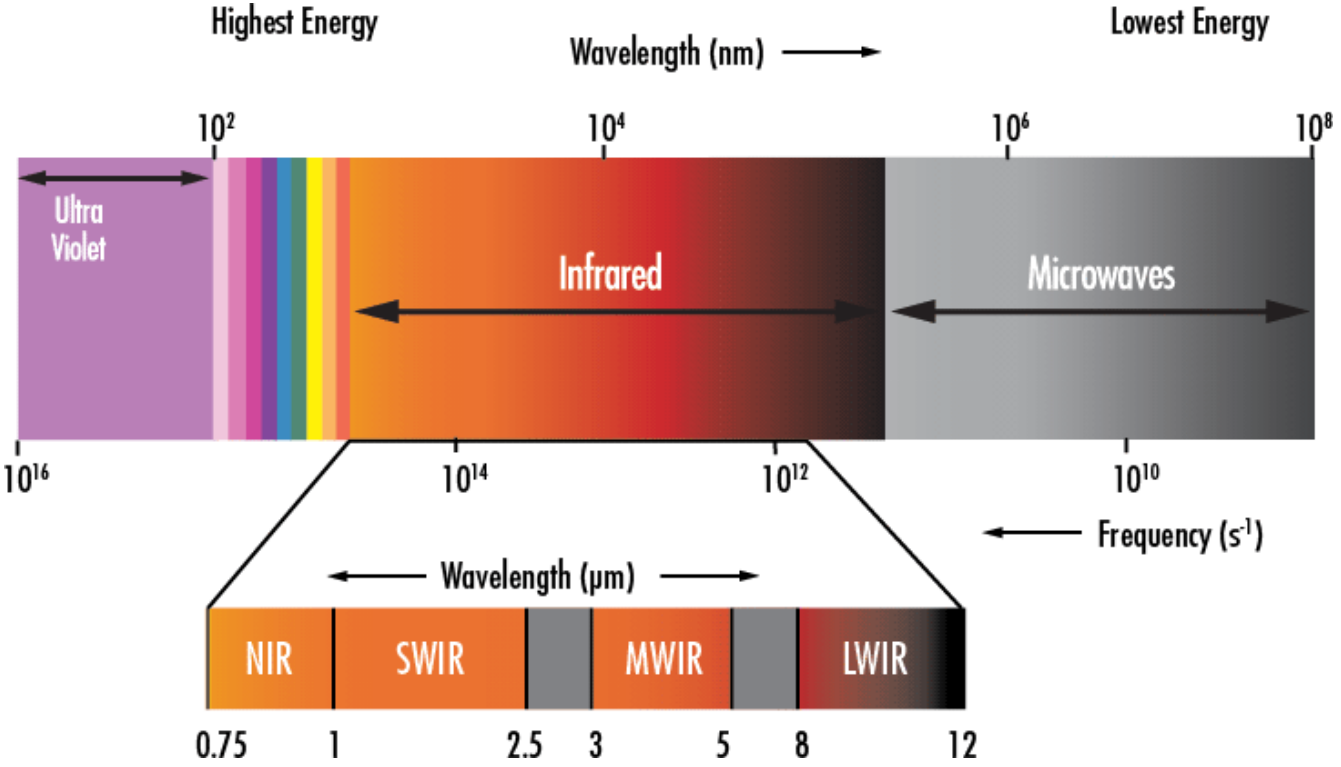
Light. Photosynthesis and Light wavelegths



Color	Wavelength
violet	380–450 nm
blue	450–495 nm
green	495–570 nm
yellow	570–590 nm
orange	590–620 nm
red	620–750 nm

Photosynthesis rate based on wavelength colour

Light. NIR equals Heat



3. **NIR 750-1,000nm**. **N**ear **I**nfrared **R**adiation

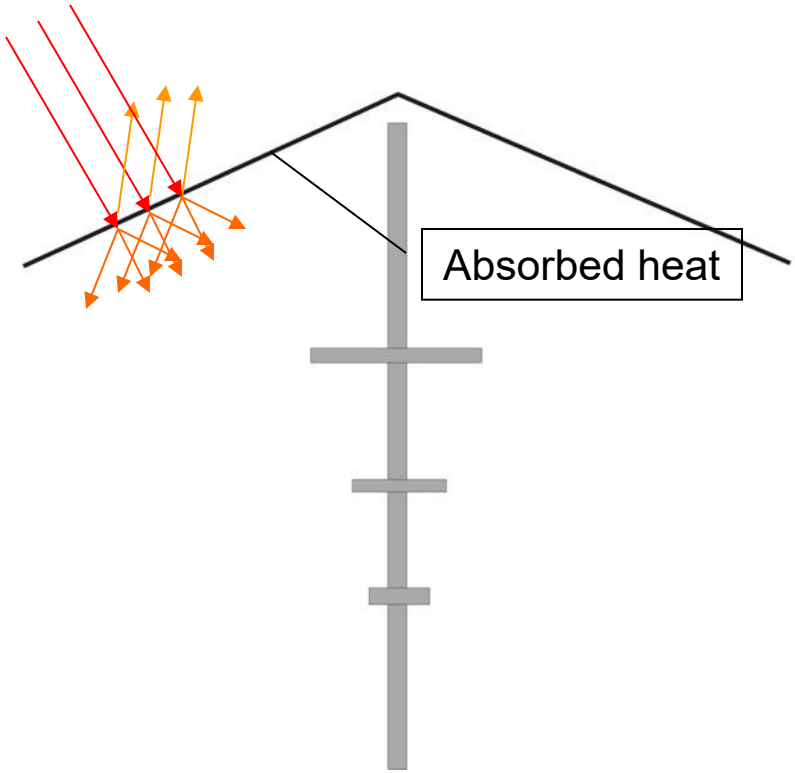
4. **FIR 3,000-10,000nm. F**ar **I**nfrared **R**adiation

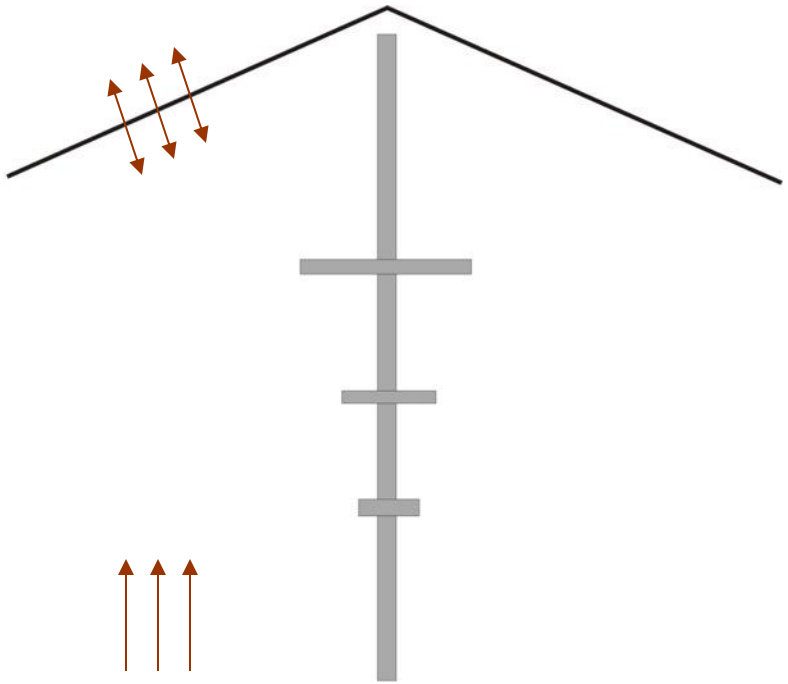
Light Diffusion.



- Direct light from clear films creates hotspots
- Diffused light reaches the bottom part of the plants that are covered by the canopy of the leaves

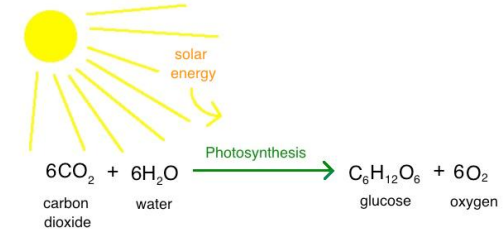
During the day sunlight penetrates the film. Some of the radiation is reflected by the upper surface, some of it is absorbed and the rest diffuses and is finally absorbed by the ground and plants. The energy absorbed by the plastic film is re-emmited. The same is true for the ground, leaves, fruit etc.





How films diffuse light

Carbon dioxide CO_2. How does the plant get CO_2?





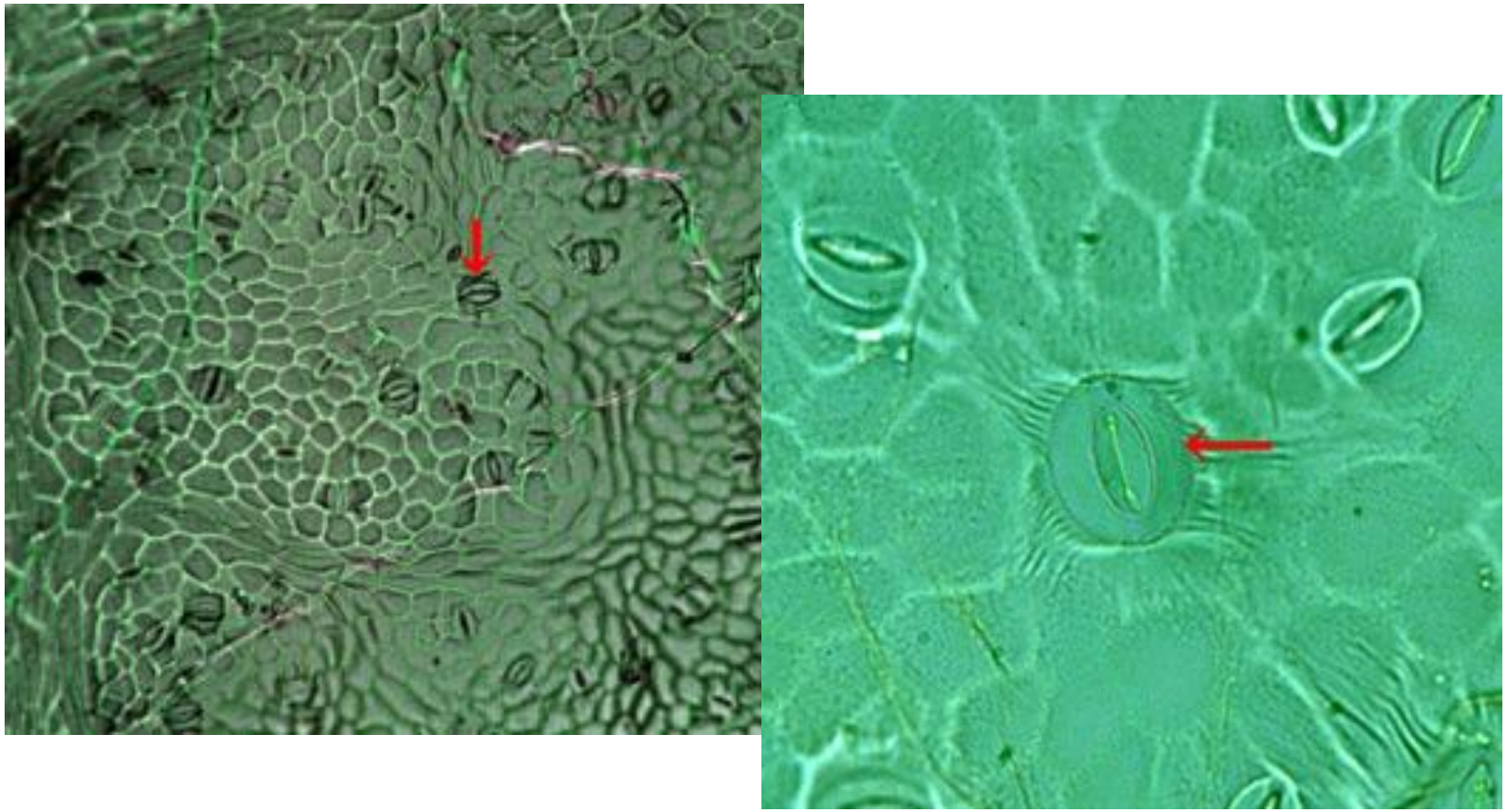






CO_2 diffuses through the back side of the leaves. To get inside the leaves CO_2 travels through the so called “Stomata”. Stomata is the Greek word for Mouth. The plant gets the food through the mouths at the back side of the leaves.

Carbon dioxide CO_2. How do stomata work?



The back side of a leaf magnified. We see the stomata on the left and a magnified Stoma on the picture at the right hand side.

VPD Vapour pressure deficit: the drying power of the air

VPD is the gap between the water vapour the air could hold and what it actually holds, measured in kPa. It is what the vine really feels — how hard the atmosphere pulls water out of the leaf.

VPD = saturation vapour pressure (set by temperature) **− actual vapour pressure** (set by humidity)

Same humidity, very different demand

0.68 kPa 15 °C · 60% RH

Cool morning — mild demand

2.24 kPa 35 °C · 60% RH

Hot afternoon — extreme demand

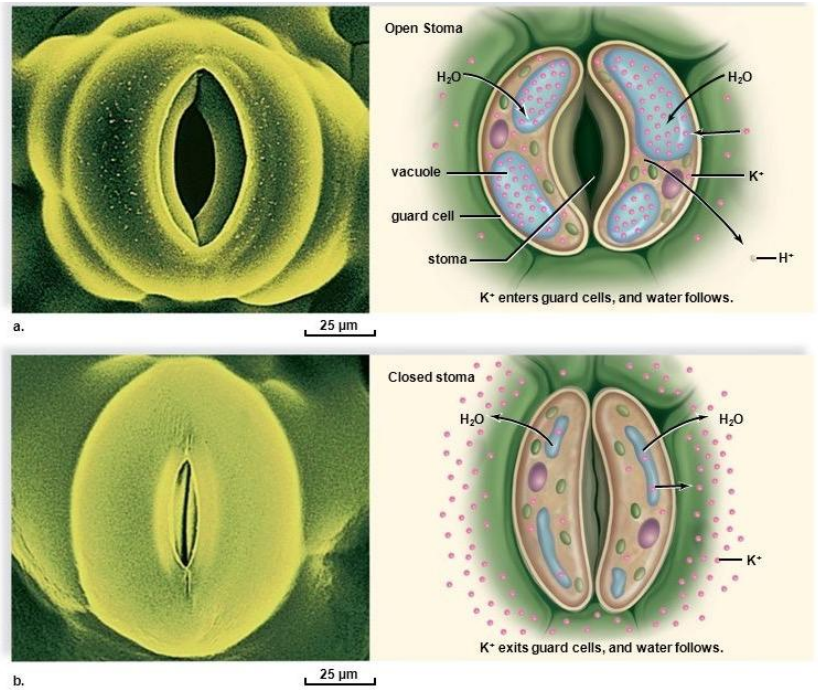
Identical RH reading — more than three times the pull on the vine. This is why VPD beats relative humidity.

What VPD controls

- Transpiration, and the nutrient flow it drives to shoots and berries
- Stomatal opening — very high VPD forces closure
- CO_2 uptake and photosynthesis
- Disease pressure — low VPD favours botrytis and mildew
- Berry sugar concentration during ripening
- Colour and aroma development

How VPD acts on the stomata

The stomata are one doorway doing two jobs: water vapour out, carbon dioxide in. VPD decides how long it stays open.



Guard cells swell and the pore opens; they go flaccid and it shuts.

Managing VPD is managing how many hours a day the stomata stay open.

Open

Guard cells take up K^+, water follows by osmosis, the cells swell and bow apart. Water vapour leaves, CO_2 enters, photosynthesis runs.

Closed

When VPD pulls water out faster than the roots resupply, K^+ exits and the pore shuts. Water is saved — but CO_2 uptake and sugar loading stop with it.

The berry has no such defence

Stomata stop functioning after veraison; water loss is then governed by the cuticle alone. The leaf can close, the fruit cannot — which is why sustained VPD above ~2.5 kPa shows up as shrivel and rachis browning.

Carbon in, water out — VPD sets the pace

CO_2 and water share one doorway. What comes in hardly changes. What goes out is set by VPD.

▼ CO_2 in ▲ water out

Cool morning

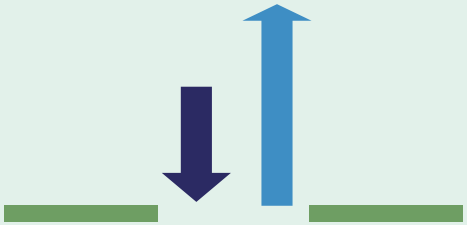
0.5 kPa



Little water lost — but little sugar made, and the air stays humid.

Mid-morning

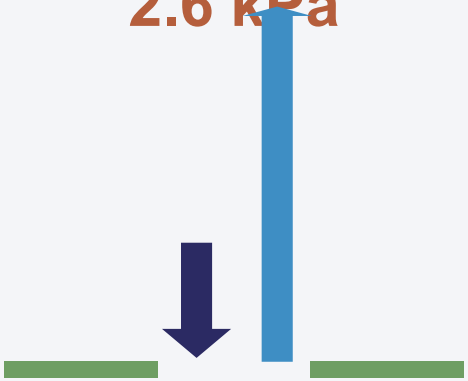
1.2 kPa



The best trade: strong CO_2 uptake for a moderate water bill.

Hot afternoon

2.6 kPa

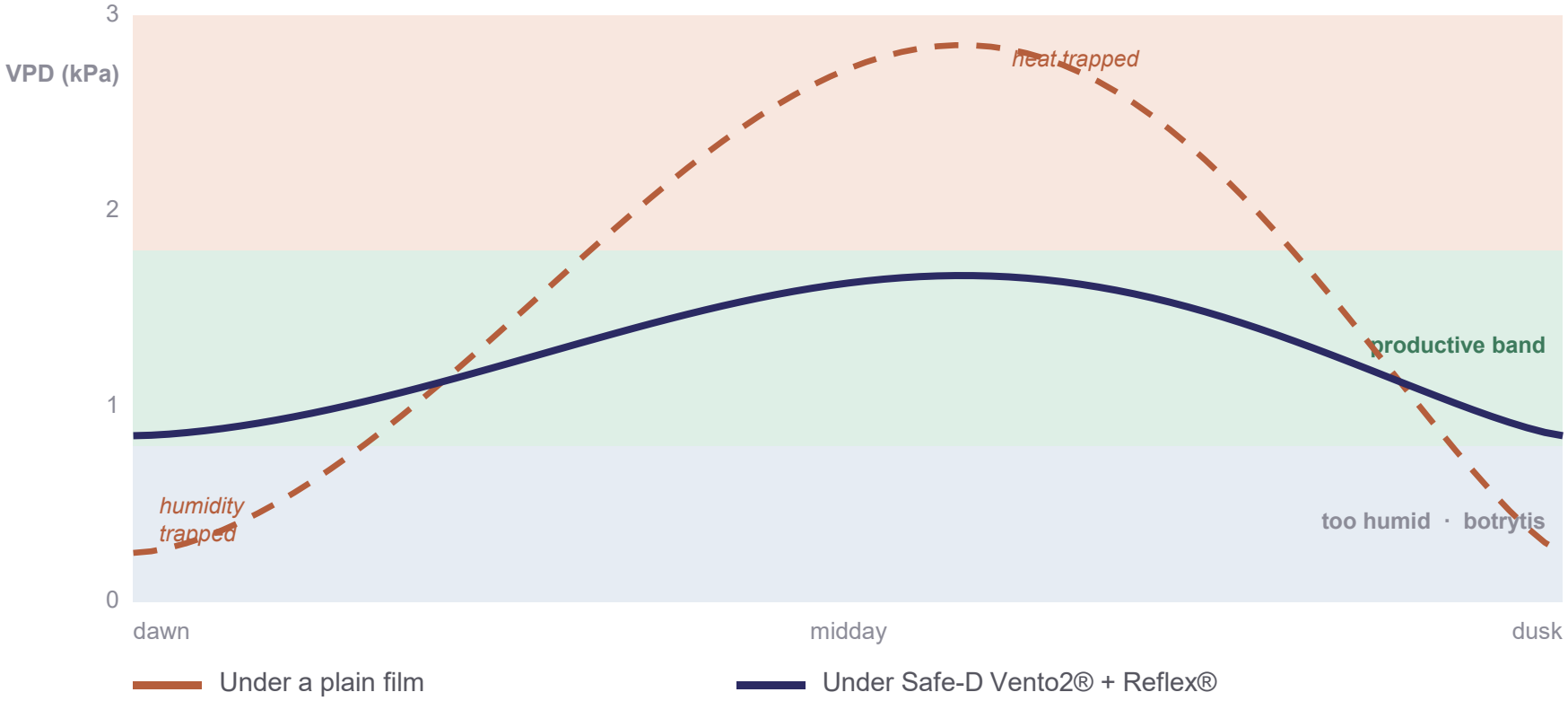


Stomata shut. Carbon stops — the water keeps going.

Same carbon in. Very different water bill. The cover's job is to keep the vine in the middle panel for more hours of the day.

What happens to VPD under the cover

A plain film traps humidity at dawn and heat in the afternoon — it pushes VPD to both extremes. Safe-D is built to cancel both.



Vento2® vents the trapped humid air. Reflex® reflects the heat before it builds. Two opposite corrections, one film.

Optimum VPD by growth stage

Growth stage	Optimum VPD	RH @ 25–30 °C	Risk if too low	Risk if too high
Budbreak / early shoot	0.4 – 0.8 kPa	70 – 80%	Uneven budbreak	Shoot desiccation
Rapid shoot growth	0.8 – 1.2 kPa	55 – 65%	Fungal disease, poor growth	Stomata close, wilting
Flowering / fruit set	0.8 – 1.2 kPa	55 – 65%	Botrytis on flowers, poor set	Stigma desiccation, shatter
Berry cell division	1.0 – 1.5 kPa	50 – 60%	Fungal disease	Water stress, small berries
Lag phase	1.0 – 1.5 kPa	50 – 60%	Bunch rot in clusters	Vine water stress
Veraison / ripening	1.2 – 1.8 kPa	40 – 55%	Poor colour, botrytis	Berry shrivel, rachis browning
Pre-harvest	1.2 – 2.0 kPa	35 – 50%	Mould, cracking, dilution	Shrivel, rachis burn

Where the cover comes in

Vento2® self-venting

Hot, humid air escapes through the ridge vents. That lifts VPD away from the botrytis window at flowering and through the lag phase.

Reflex® NIR reflection

Reflecting near-infrared cuts the temperature spikes under the film, holding VPD below the level where berries shrivel and the rachis browns.

The cover as a VPD tool

A technical cover manages both ends of the range — not just rain exclusion, but the atmosphere the vine actually grows in.

Is it always optimal under the cover?

No. A cover changes VPD — it does not automatically improve it. Trapped humidity pushes it too low at dawn, trapped heat pushes it too high by afternoon. It has to be managed.

Four levers you actually control

1 The film



Vento2® venting raises VPD when humid air stagnates. Reflex® NIR reflection lowers it when the afternoon runs hot. Thermicity additives hold night temperature and limit condensation.

2 The structure



More height means more air volume to buffer swings. Vento2R® side vents add cross-flow. Retractable systems let you take the cover off when ambient conditions are already right.

3 The canopy



Dense bunches hold a humid pocket whatever the ambient VPD. Leaf removal in the bunch zone and shoot positioning restore airflow exactly where botrytis starts.

4 Water



Irrigation cannot lower VPD — but it decides whether the vine can meet it. Match supply to atmospheric demand, above all through berry cell division.

And measure it under the film, not at the weather station. Temperature and RH sensors in the bunch zone cost little and change the decisions.

How do we measure VPD?

There is **no** VPD sensor. You measure temperature and humidity and compute it — so where you put the probe matters more than what you spend.

$$SVP = 0.6108 \times \exp\left(\frac{17.27 \cdot T}{T + 237.3}\right) \qquad VPD = SVP \times \left(1 - \frac{RH}{100}\right)$$

Temperature sets what the air could hold. Humidity sets what it does. The gap is VPD.

Three things decide whether your number means anything

Shield the sensor

Unshielded in sun a probe reads several degrees hot. SVP rises exponentially with temperature, so a 3 °C error inflates VPD by about 20%.

Put it where the plant is

Under the film, at bunch height, inside the canopy — plus one ambient sensor outside. That pair is what proves what the cover actually does.

Log every 10 minutes

The daily swing is the whole story. Hourly sampling misses the afternoon peak, which is the number that does the damage.

Air VPD is not leaf VPD. A freely transpiring leaf runs 2–5 °C below air temperature; one with closed stomata runs above it. On hot afternoons an air reading understates what the vine actually feels — most of all under a cover carrying NIR load.



Choosing the right cover

Protection goals, cover types and the Safe-D® Vento® range

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Choosing a cover for table grapes

Four properties, and they pull against each other. **The ultimate question is what is the objective?**

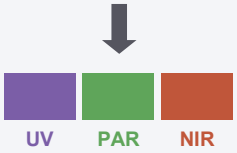
1 Mechanical properties



wind load · eyelets

Pergola spans carry the wind load. Tensile strength, creep resistance and thermo-fused eyelets give Force 9 tolerance and 3–5 seasons.

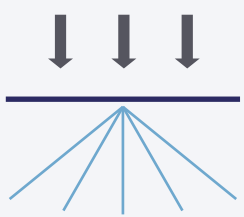
2 Light transmission — UV · visible · NIR



three wavebands

PAR builds Brix. UV drives anthocyanin in the coloured varieties. NIR arrives as heat on the bunch zone.

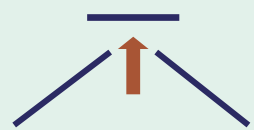
3 Diffusion (haze)



beam → scattered

Talc, $CaCO_3$ and TiO_2 scatter the beam into the lower canopy and the bunch zone. Fewer hotspots, more even ripening.

4 Ventilation — Safe-D Vento2®



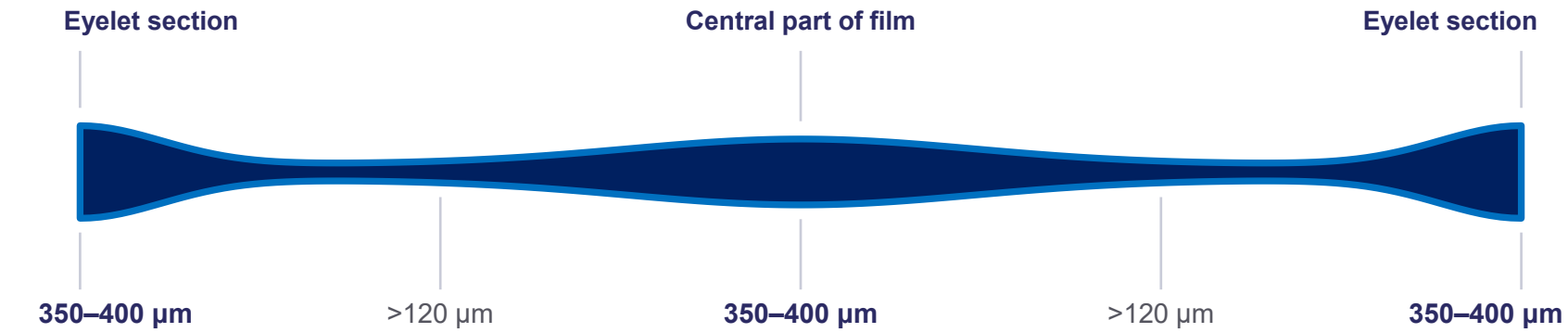
vent under a hood

Ridge vents under a heat-sealed hood: humid air out, rain stays out. 4.80% open area against 0.57% on the original Vento®.

For table grapes: ventilate first with Safe-D Vento2®, then pick the UV variant the colour needs.

Mechanical properties of technical covers

Safe-D gradual thickness variation — thicker where the film is held, thinner across the span.



Cross-section through the film width · thickness exaggerated for clarity



Safe-D cover in service

Same material throughout

Eyelets are made from the exact same mix as the film.

Thermo-fused, not attached

One body, with no seam to fail.

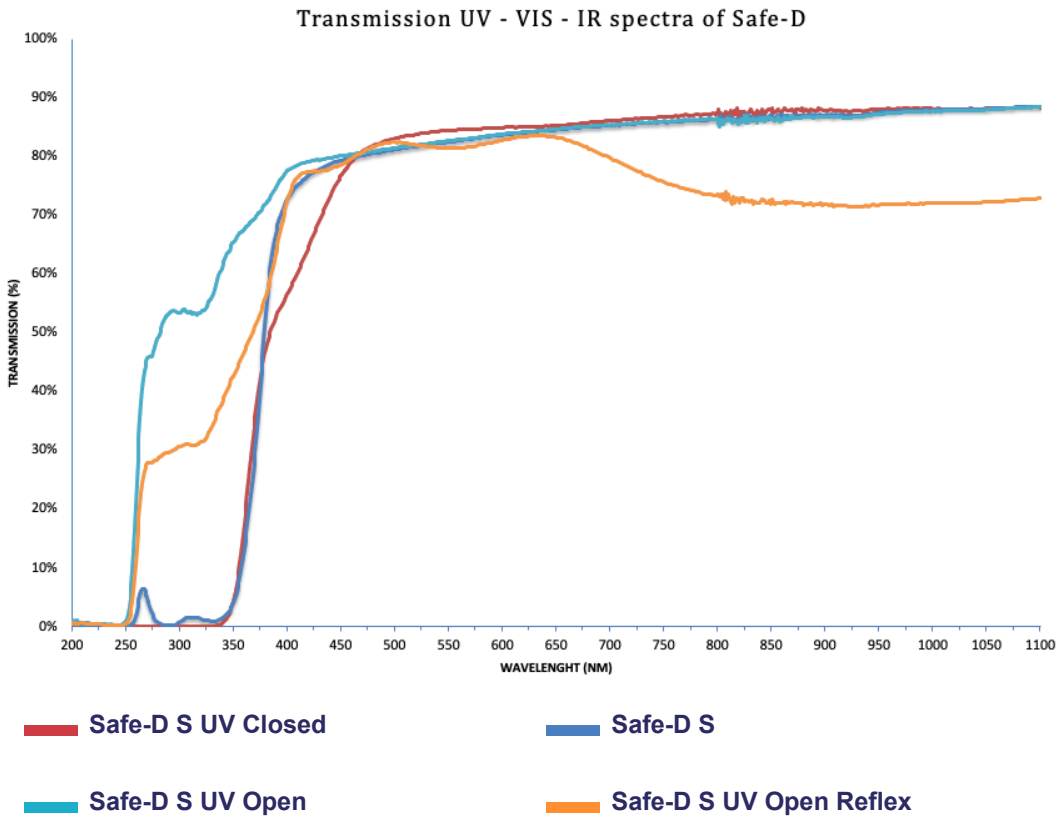
Thickness varies gradually

Eyelet and film change together, so load has nowhere to concentrate.

Force 9 (Beaufort) — the wind these films accommodate.

Optical properties of technical covers

Transmission spectra measured by spectrophotometer under artificial light — one film family, three UV strategies.



Safe-D UV Open

Hindered-amine light stabilisers (NOR-HALS) transmit more than 65% of UV. Drives secondary metabolites — flavonols, anthocyanins — and colour development.

Safe-D UV Closed

Nickel complexes and UV absorbers transmit 20% of UV. Removes the excess for UV-sensitive crops such as kiwi. Less colour development, which suits white varieties.

Safe-D Reflex

Inorganic materials in the polymer matrix reflect NIR between 700 and 1400 nm, removing temperature spikes under high sun and high air temperature.

Self-vented covers: Safe-D® Vento2®



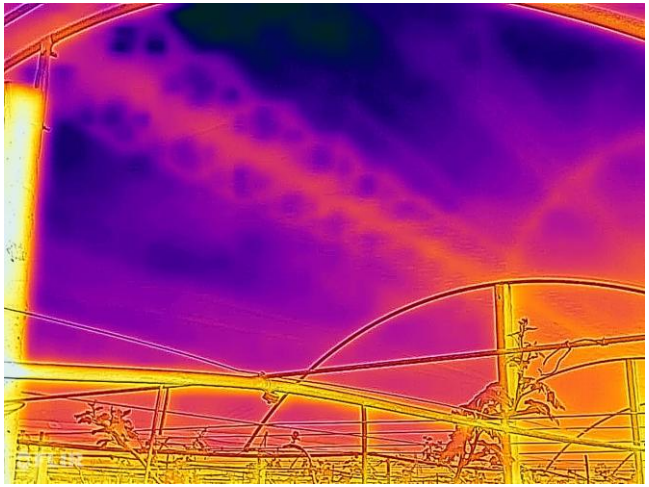


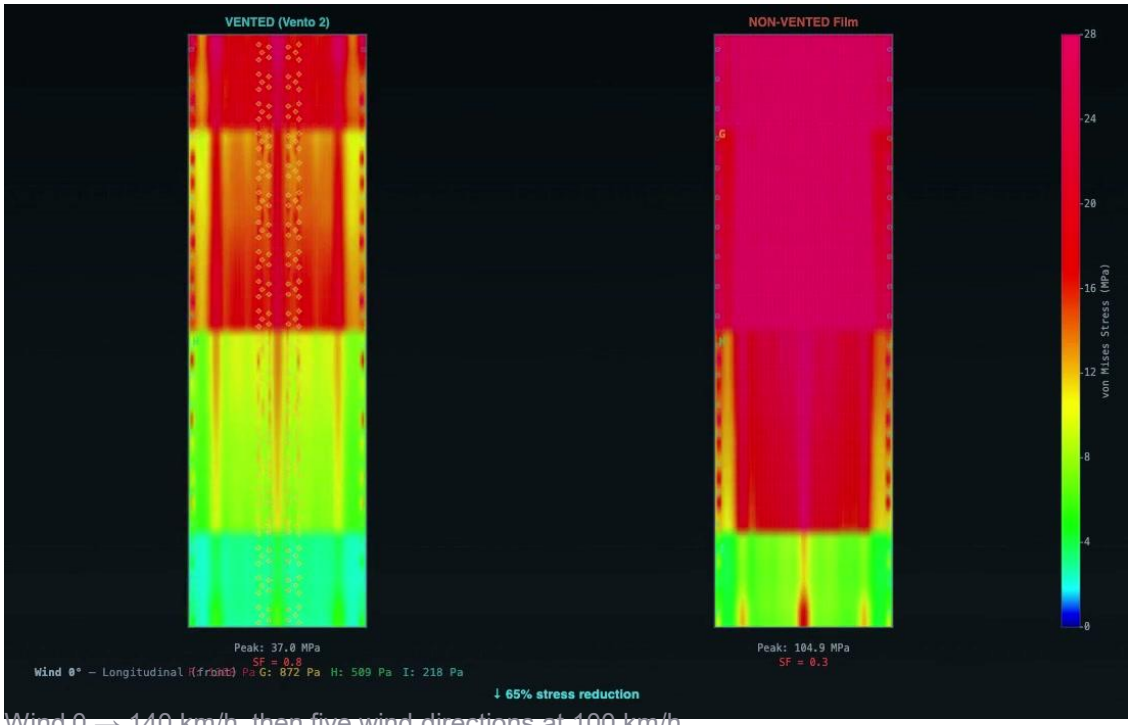




Table grapes UV Closed and UV Open Vento2® — Chile, Sicily (Italy)

One more thing

What the vents do to the pressure on the film — and to everything holding it up.



Wind 0 → 140 km/h, then five wind directions at 100 km/h

Pressure on the film

Ridge vents bleed the pressure differential before it can build. Lower Cp, lower net load across the membrane.

Stress in the film

At 140 km/h head-on: 37.0 MPa vented against 104.9 MPa unvented. Safety factor 0.8 against 0.3.

Load into the structure

The film hands its tension to eyelets, wires, posts and anchors. Less stress in the film means less reaction at every fixing.

65% lower peak stress at 140 km/h. The structure only ever sees what the film transmits.



Safe-D® in the field

Installations across Spain, Italy, Chile and the United States

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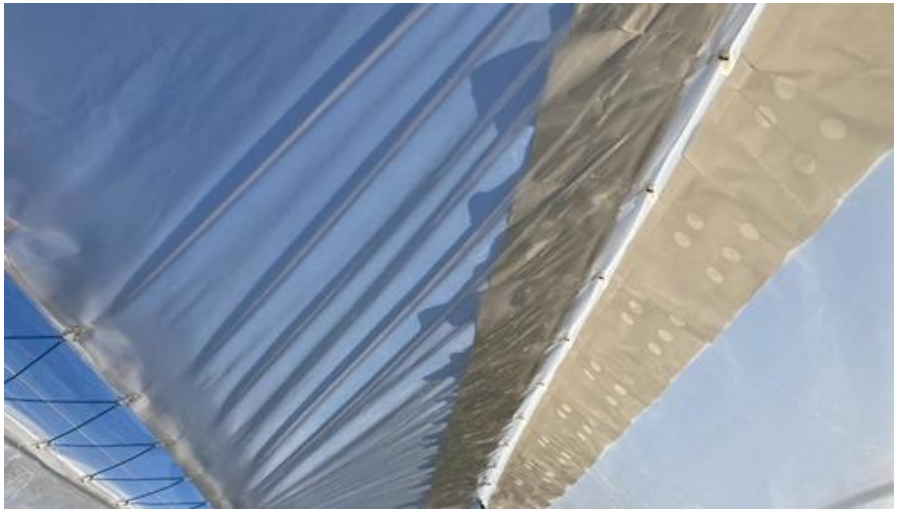
Table grapes UV Open Vento2® — Spain





Vento2R® UV Closed and UV Open — Alicante, Spain

New developments (PF)









Vento PF (protective film) White stripe welded onto the film acts as a winter protective cover; top left shows the older separate-film system it replaced

Retaining the heat





Semi-mechanised perimeter covers Cherry orchard





Vento2® manually retractable system Chile



Installation and tying systems

Bungee, navet and carabiner configurations

Safe-D® protection systems

Pull system with V-shaped bungee + navet units and carabiner





Safe-D® protection systems

Segmented system with 1-1 bungee + navet units and carabiner







Why Safe-D®

What you get back

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Reasons to use technical covers

What the grower gets back, and what delivers it.

3–5
seasons
continuous solar exposure, depending on film variant

30–50%
less irrigation water
through lower evapo-transpiration under the cover

65%
lower peak film stress
Vento2® against unvented film at 140 km/h

And what does it

High PAR transmission with light diffusion more light reaching deeper into the canopy, and reaching it evenly

Safe-D Vento2® self-venting humid air released at the ridge; wind pressure on the structure cut

Safe-D Reflex® NIR reflection the afternoon temperature spike removed before it reaches the fruit



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Summary

Three things to take away.

1

There is no best film — only the right match to the objective.

Mechanical strength, light transmission, diffusion and ventilation pull against each other. The crop, the climate and the structure decide which one you give up.

2

The economics are a balance, not a price.

Film cost per season, placement, folding and handling on one side. Fruit quality, yield and pack-out grade on the other. Only the second side pays.

3

The savings are real and measurable.

Irrigation water down 30–50%, with fertiliser and phytosanitary inputs following — because the cover changes the environment, not just the roof.

The objective

The most fruit, at the best quality, from the fewest resources.



Innovation & Business Development

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