

11th International Table Grape Symposium

Murcia, Spain.

28th September to 2nd of October 2026

https://11itgs.es/

fruit attraction 06 - 08 OCT **2026**

THE ART OF PRODUCING GRAPES

11 ITGS

Int. Table Grape Symposium

www.11itgs.es

AgroFresh

"What's in the Postharvest Toolbox? Essential Tools for Maintaining Table Grape Condition"

Key concepts

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August 2026



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PROTEKU EUROPA INFRUTA CHILE
'A grape idea"

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XPERIENCE

Table Grape Roadshow 2026





Objective of this presentation

I am not here to tell you what to do or how to do it. My aim is simply to show how others address similar challenges and to present practices that could be adopted within your own operations. The objective is to encourage you to rethink what you do, how you do it, and to critically evaluate the outcomes you achieve.
We are facing:

- Climate uncertainty.
- Logistical challenges.
- A public sector that often lacks responsiveness and empathy towards the needs of the industry.

So, what can we do?

Technology enables us to produce fruit with a **postharvest life of 70–80 days from harvest**. If market conditions are favourable, we may sell it within minutes; however, to make that possible, the fruit must first be properly prepared, and its senescence slowed in order to maintain the fruit condition throughout the supply chain.

Houston, we have a problem.

(Jack Swigert, Apollo 13 mission, 13 April 1970).



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Do I really have **40 years of experience**, or just **one year of experience repeated 39 times**?





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BRCGS

Packaging and Packaging Materials

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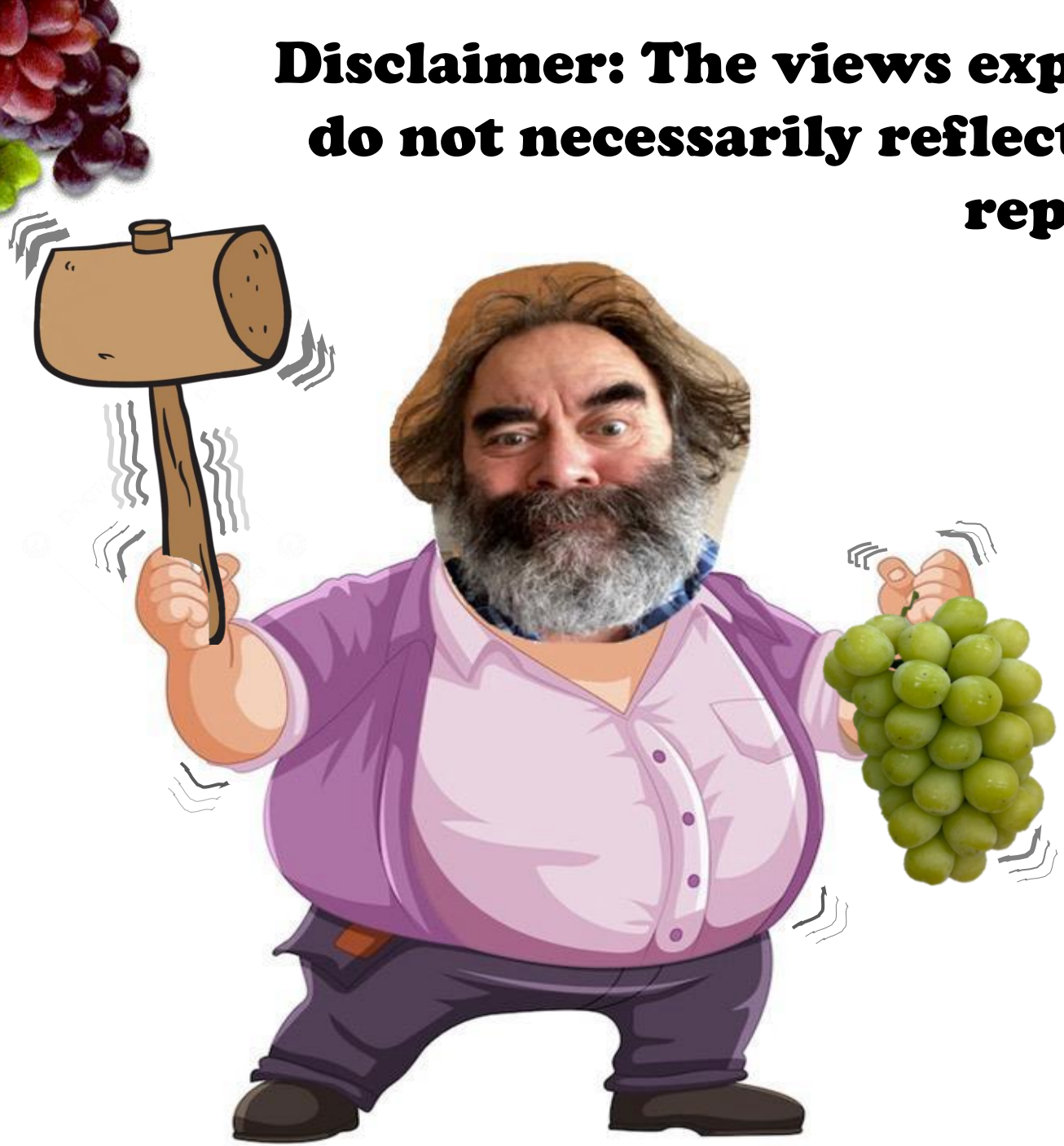
We manufacture our own SO_2 pads in our three BRCGS-accredited facilities, following the highest manufacturing standards to ensure they are safe for use and be in contact with food.

We do not outsource the production of our pads to third parties.

Disclaimer: The views expressed are solely my own and do not necessarily reflect those of the organisations I represent.



"You don't have to agree with me on everything, but neither do you have to agree with yourselves"

“If you are doing it well,
continue doing it,
but make sure you understand
why it works.”


JN Bank
BOLT
RACERS 2017

Talent

What made "*Usain Lightning Bolt*" the best sprinter in history?

- Genetic
- Training with discipline
- Mental state and mental work, to keep the flexible but pre-set strategy
- Food or Diet (Nutrition)

→ **Expression of his Maximum Genetic Potential**



Source: O. Salgado 2024/2026



Boer maak ’n plan: not any more……***Boer het vooraf bepaalde planne***

Climate uncertainty

Abiotic Stress



65-75%

Biotic Stress



25-35%

Source:" Crop production under abiotic stresses: Management options and crop reactions". T.Begna et al 2026

Logistic



30-50%

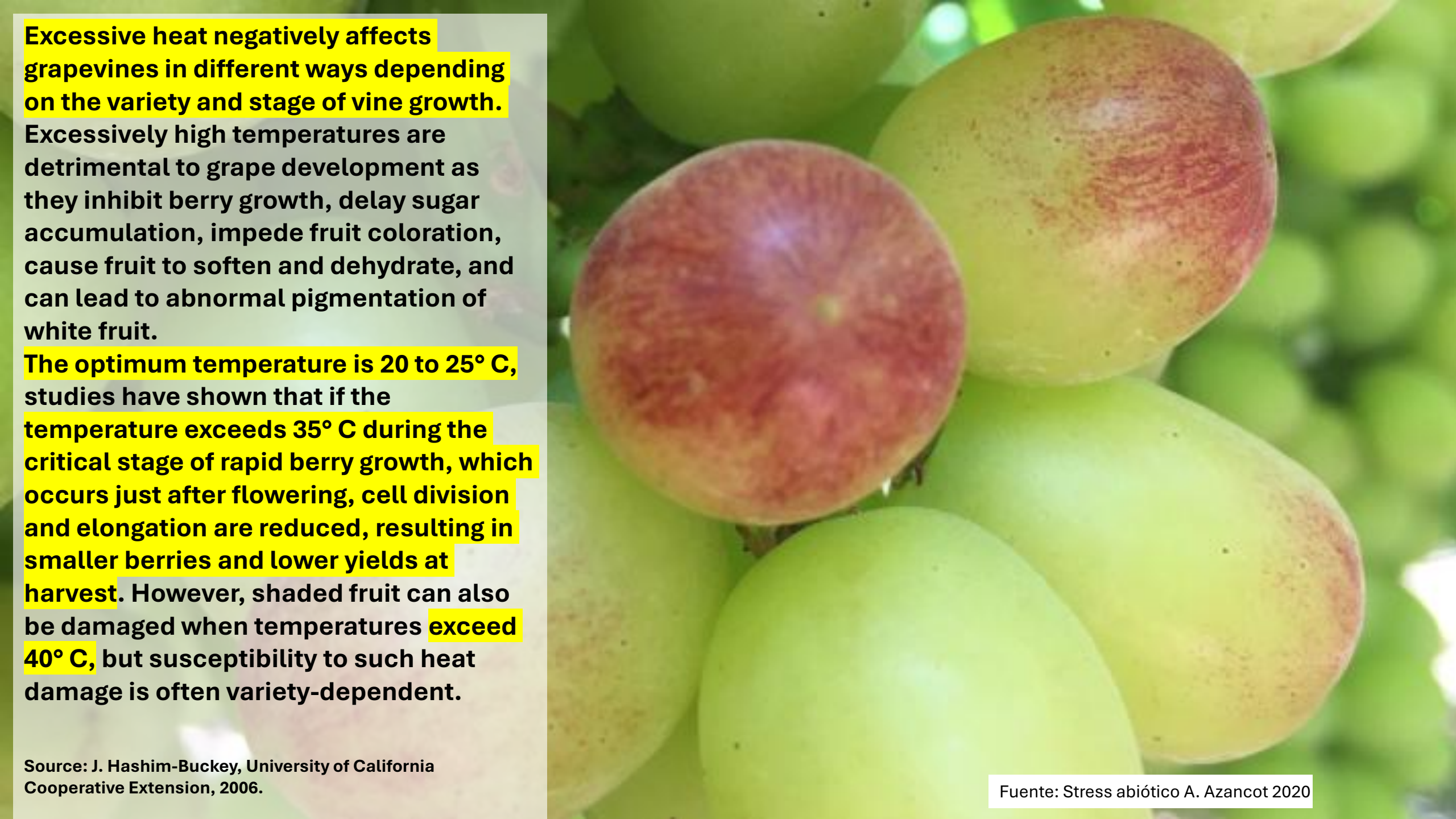
(Fruits and vegetables)

Source: www.fao.org/newsroom/detail/A-major-step-forward-in-reducing-food-loss-and-waste-is-critical-to-achieve-the-SDGs/

Excessive heat negatively affects grapevines in different ways depending on the variety and stage of vine growth. Excessively high temperatures are detrimental to grape development as they inhibit berry growth, delay sugar accumulation, impede fruit coloration, cause fruit to soften and dehydrate, and can lead to abnormal pigmentation of white fruit.

The optimum temperature is 20 to 25° C, studies have shown that if the temperature exceeds 35° C during the critical stage of rapid berry growth, which occurs just after flowering, cell division and elongation are reduced, resulting in smaller berries and lower yields at harvest. However, shaded fruit can also be damaged when temperatures exceed 40° C, but susceptibility to such heat damage is often variety-dependent.

Source: J. Hashim-Buckey, University of California Cooperative Extension, 2006.



Fuente: Stress abiótico A. Azancot 2020

Autumn Crisp UK season 2022 origin Spain





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Abiotic Stress

US – CA, Autumn King almost imperceptible seed trace November 2015, Wholesale Market of Mumbai , India





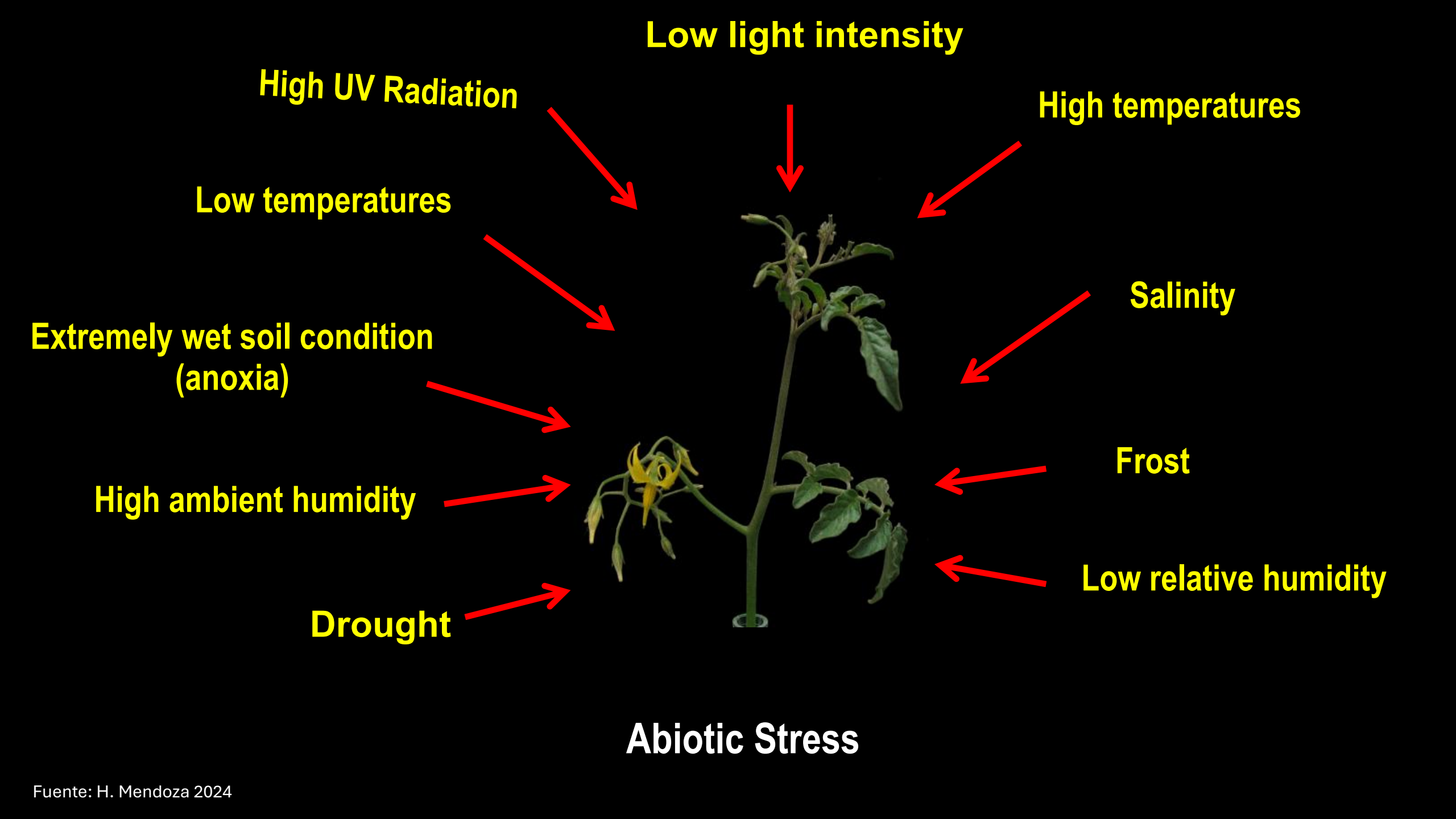
Fidelibus (https://www.growingproduce.com 2022) It is a phenomenon associated with high temperatures during flowering and fruit set and the management of growth regulators.



Nashik India storm till last weekend 19th of October 2024 affection the grape which will be harvest from early December till week 6 / 2025

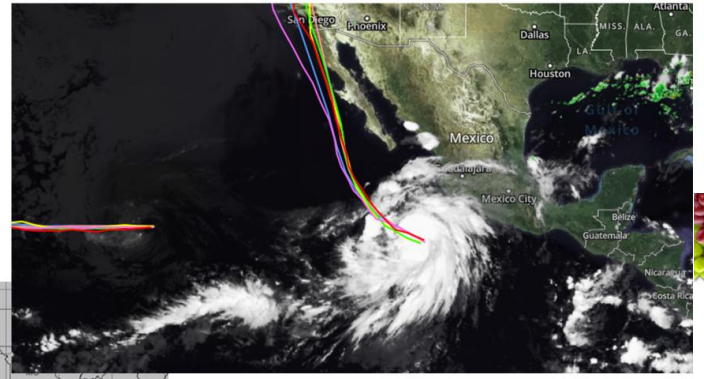


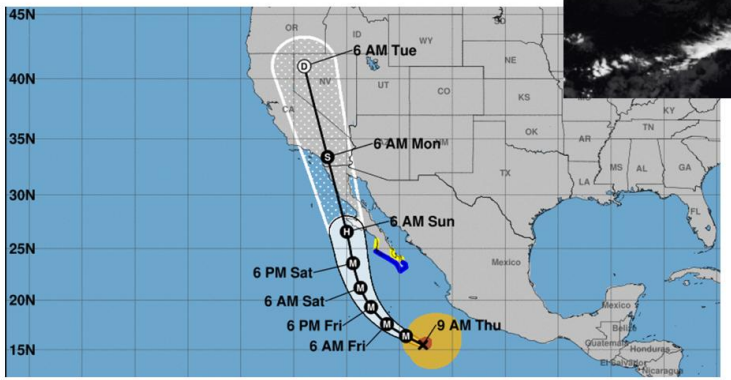




Fuente: H. Mendoza 2024

Hurricane Hilary

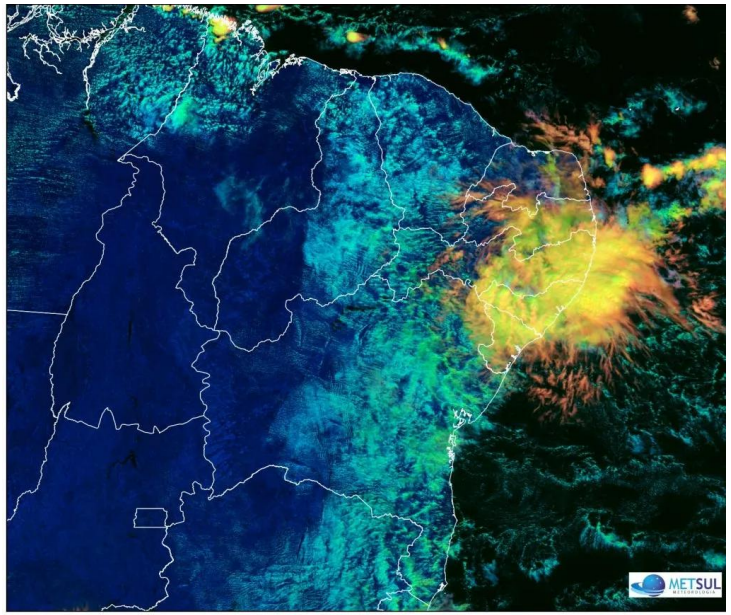




The probable path of Hurricane Hilary on Aug. 17, 2023. (NOAA)

May 25, 2024, Northeast Brazil, as of today July 30 1,500 mm





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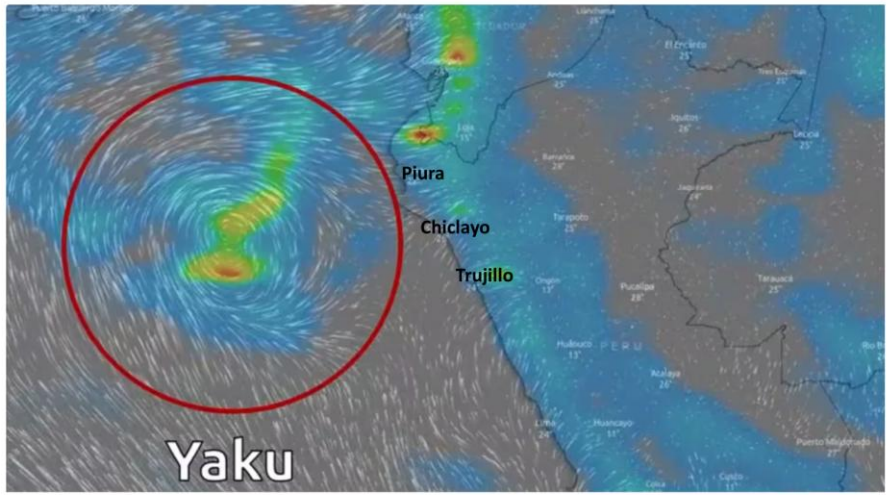
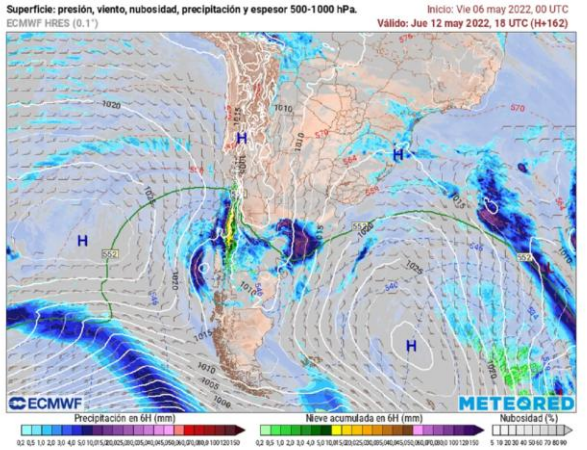
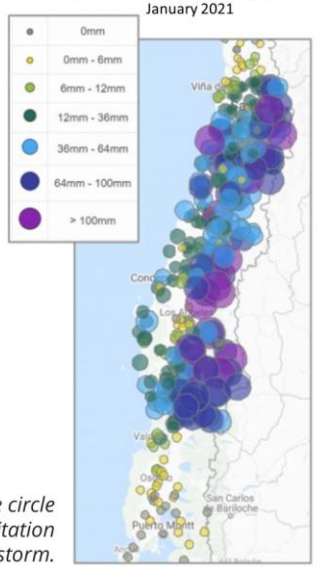
ciclón "Yaku"
Marzo 2023



Atmospheric River Chile January 2021

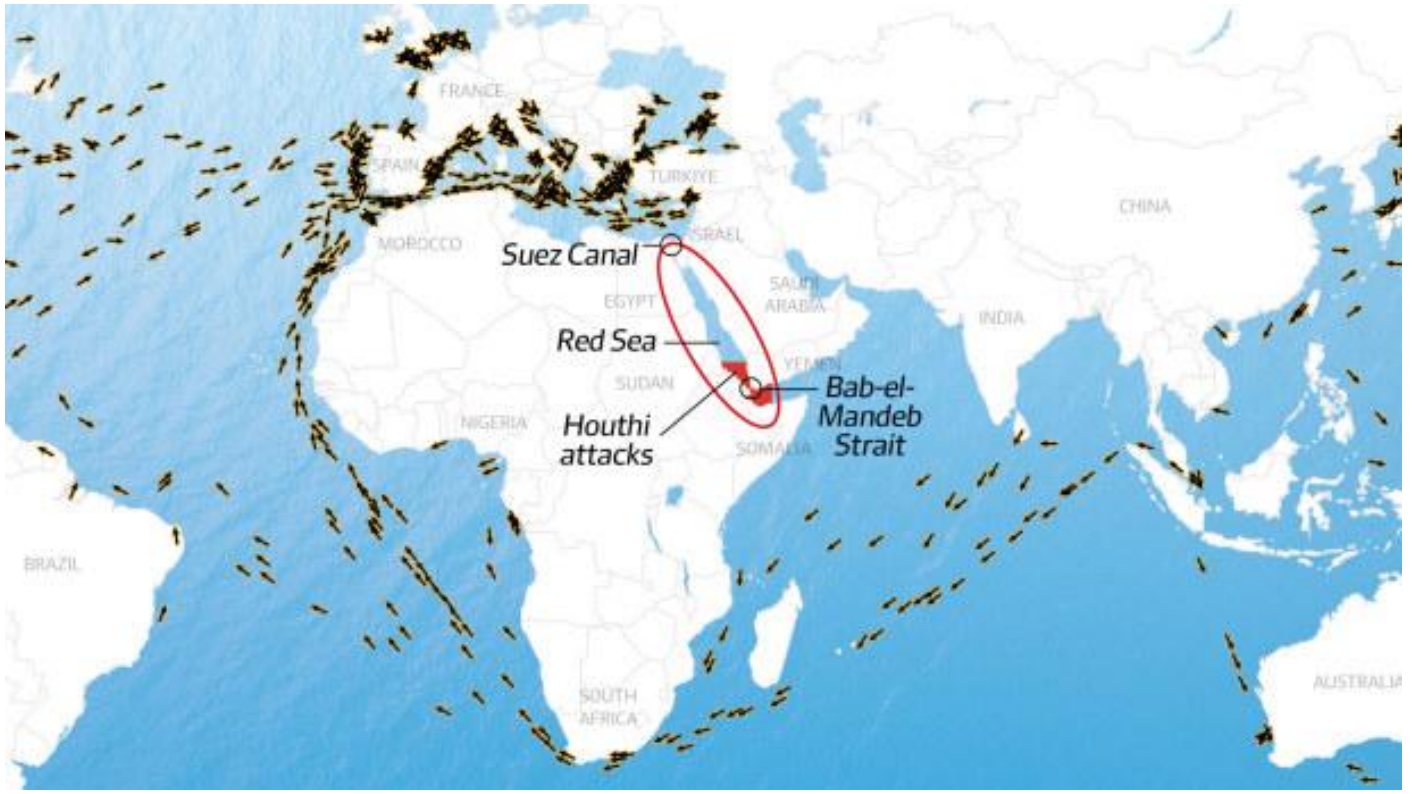


Accumulated rainfall between 27th to 31st January 2021



The size and color of the circle shows the precipitation accumulated during the storm.


The Indian EXPRESS
San Francisco
New York City
United States
NORTH ATLANTIC OCEAN
NEW ROUTE: 5,200 nautical miles
PANAMA CANAL
EQUATOR
South America
SOUTH PACIFIC OCEAN
OLD ROUTE: New York to San Francisco: 13,100 nautical miles
Graphic: IE Design


FRANCE
SPAIN
TURKIYE
MOROCCO
ISRAEL
CHINA
Suez Canal
EGYPT
SAUDI ARABIA
INDIA
Red Sea
YEMEN
SUDAN
Bab-el-Mandeb Strait
NIGERIA
Houthi attacks
SOMALIA
BRAZIL
SOUTH AFRICA
AUSTRALIA





The Market is the Market

Sainsbury´s October – November 1985

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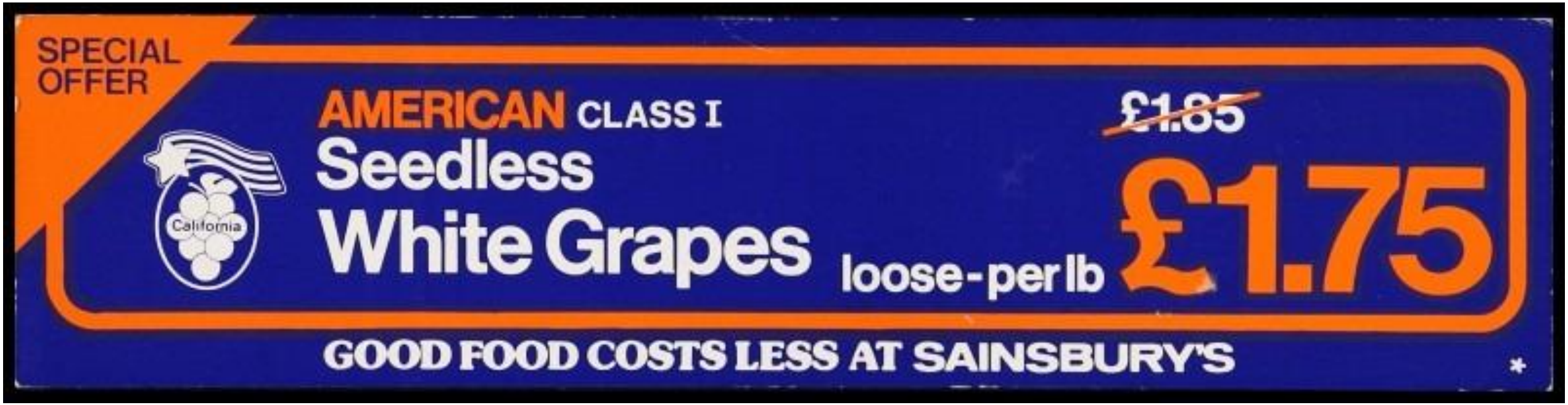

2022 and 2023 October – November
£1.50 – 1.75 /lb within the top high-end UK retails

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Source: compiled by =. Salgado 2021, label picture from Paul Farmer 2021



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2017



2008

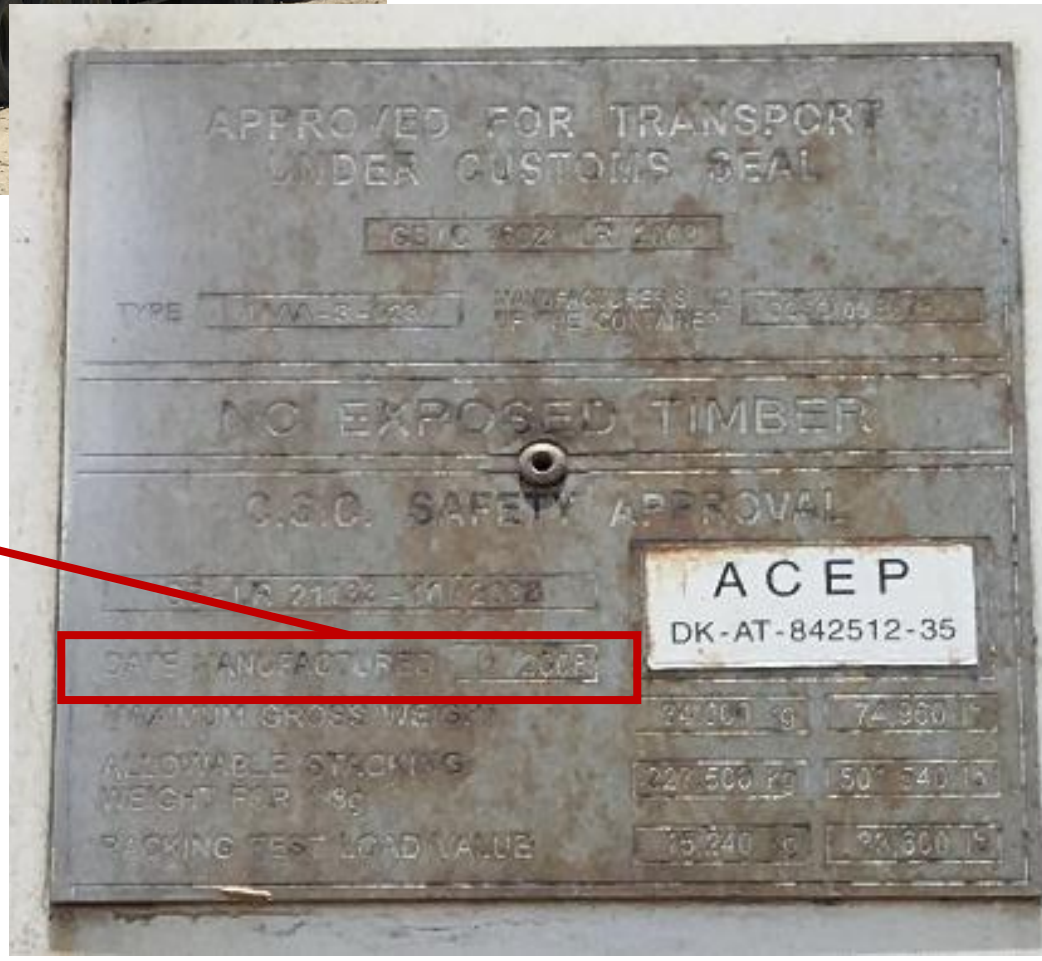
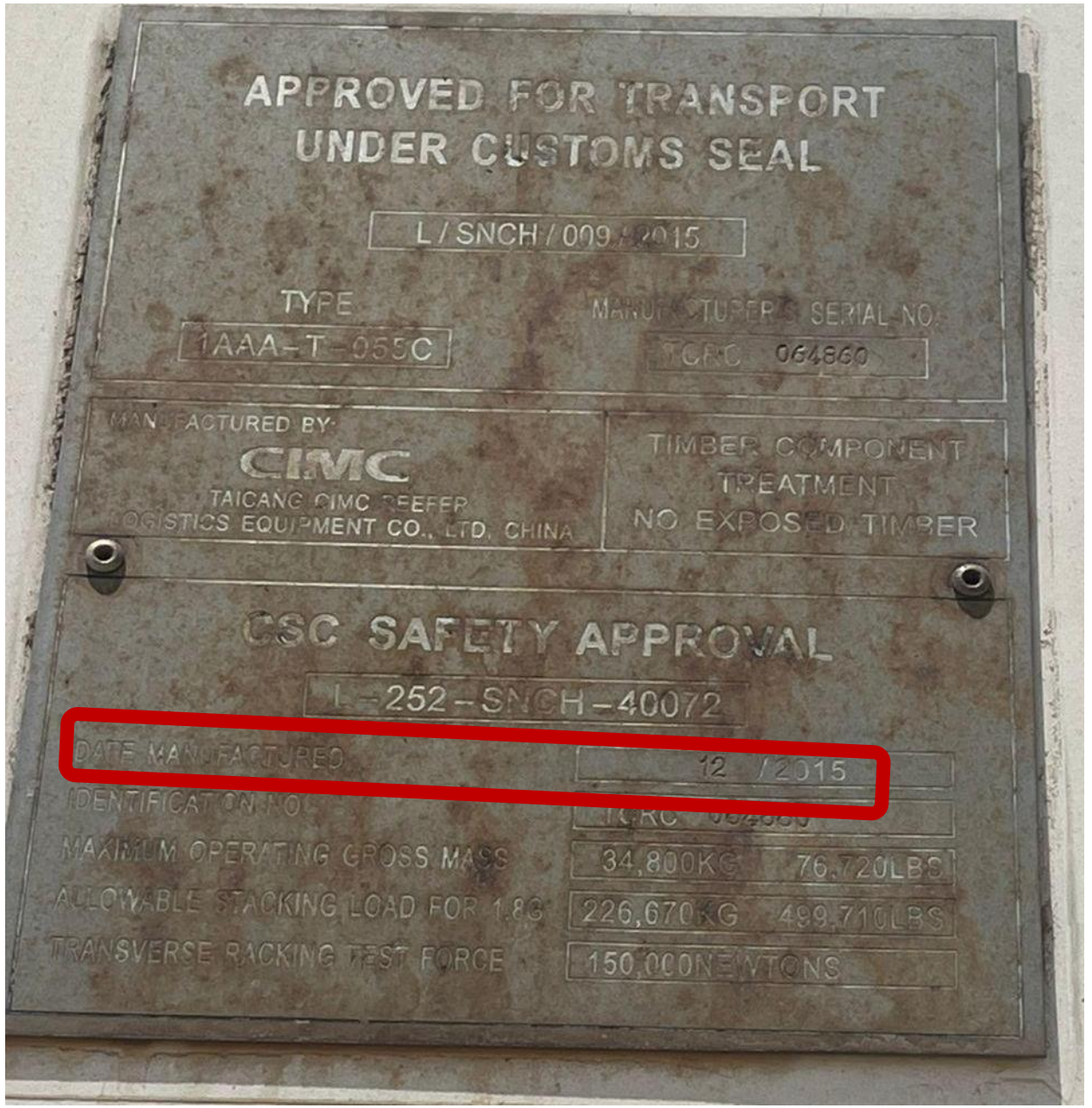


Foto: O. Salgado, Piura 2017



Manufactured 2010



Manufactured 2015

Picture Egypt June 2026



Evergreen
Suez Canal March 2021





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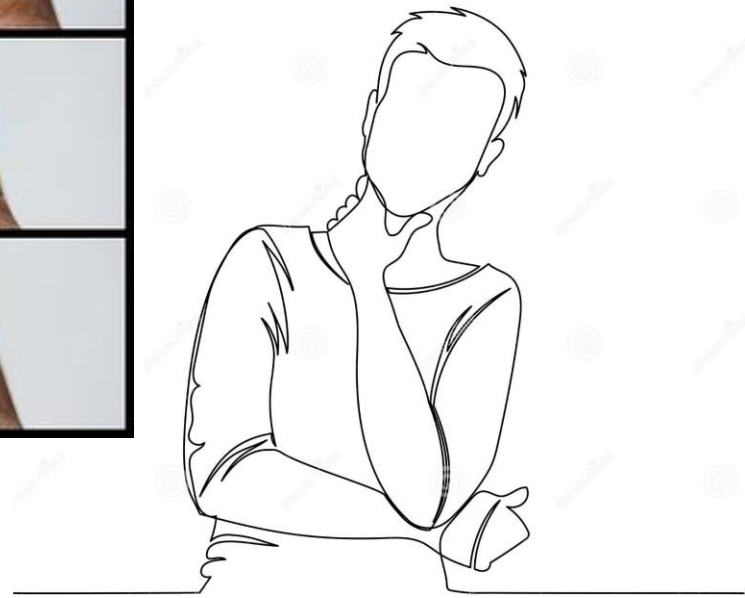

What Then are the Problems?
What is in our hands....to solve??



CGSociety.org
Copyright (C) Jose Maria Andres, submitted 05 March 2009

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Technology may range from the very simple to the highly sophisticated, yet it must be grounded in science. However, the real secret lies in how to use it.





Fall in love with the problem, not the solution

Uri Levin
1965

waze

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Timemark
Foto 100% Real
© DMV3HAWRR9W3W6 - Timemark Verified

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Source; by permission of Unitec


RACK
3
RACK
4


AUTOSAT
DO NOT STEP
6
PALLETRUNNER







Ctrl + C

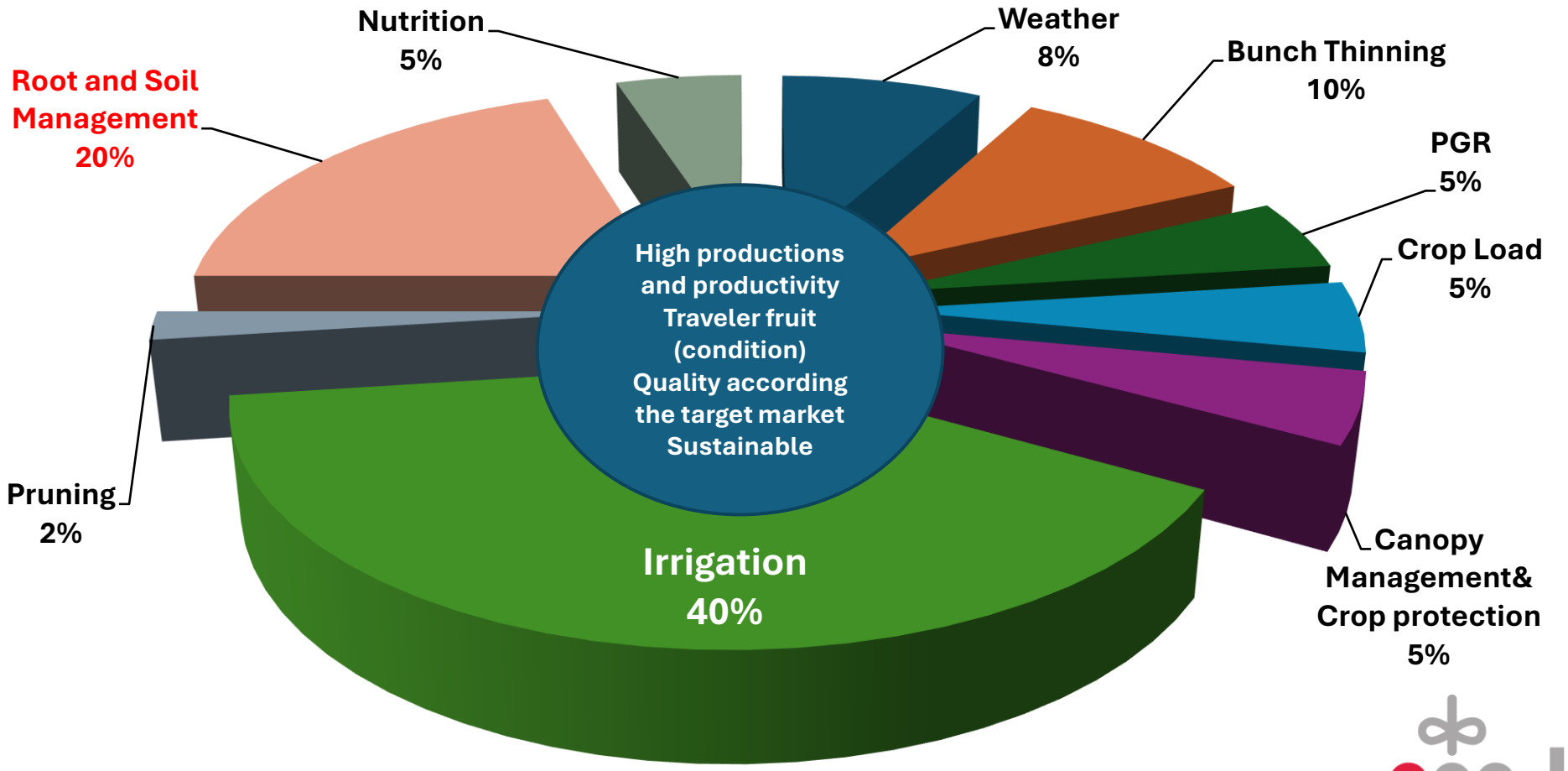
Ctrl + V



Caral, Peru Autumn Crisp



Agronomic Impact of some Techniques in a well manage Export Table Grape production unit

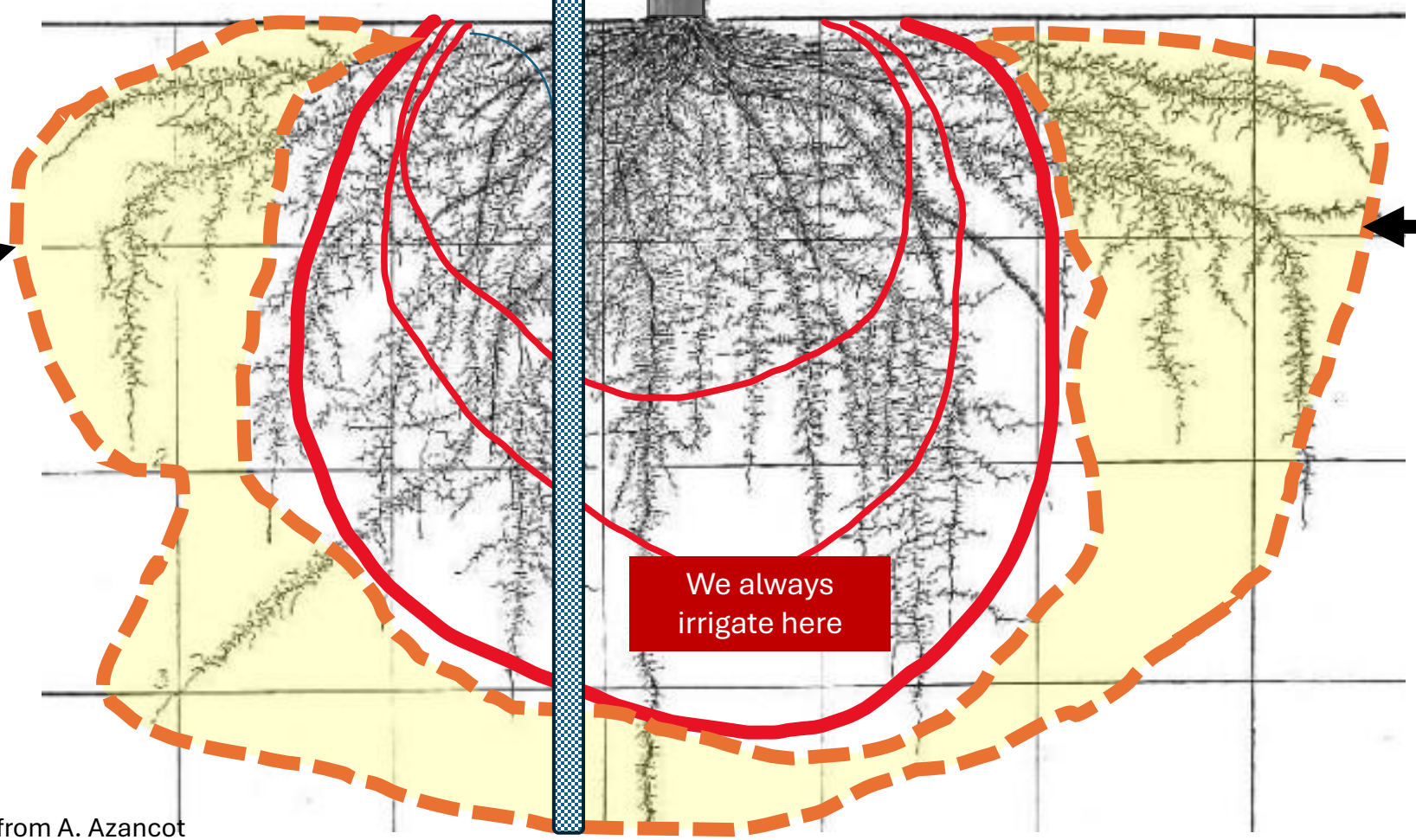


Source: Modified by O. Salgado 2023 from D. Lujbetic et al 2004

Where do I get to with my irrigation and more importantly, where do we not get to with my irrigation?
And when did the ET0 spiked up, we act or pro act?

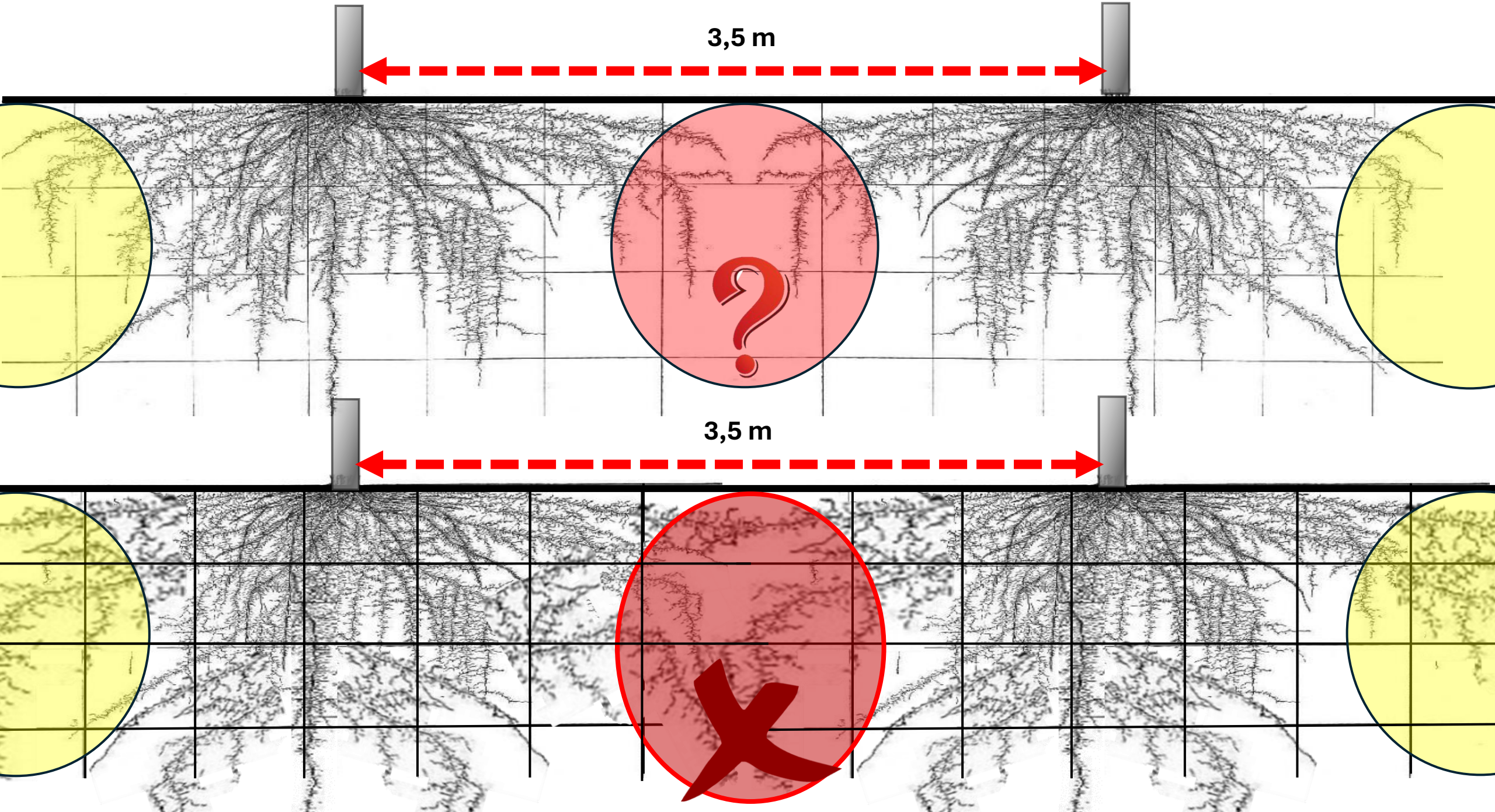
The problem is usually between the rows, which we don't want to see.
Our instruments allow us to evaluate in depth, not laterality.

Pay attention to where we are not irrigating



Pay attention to where we are not irrigating

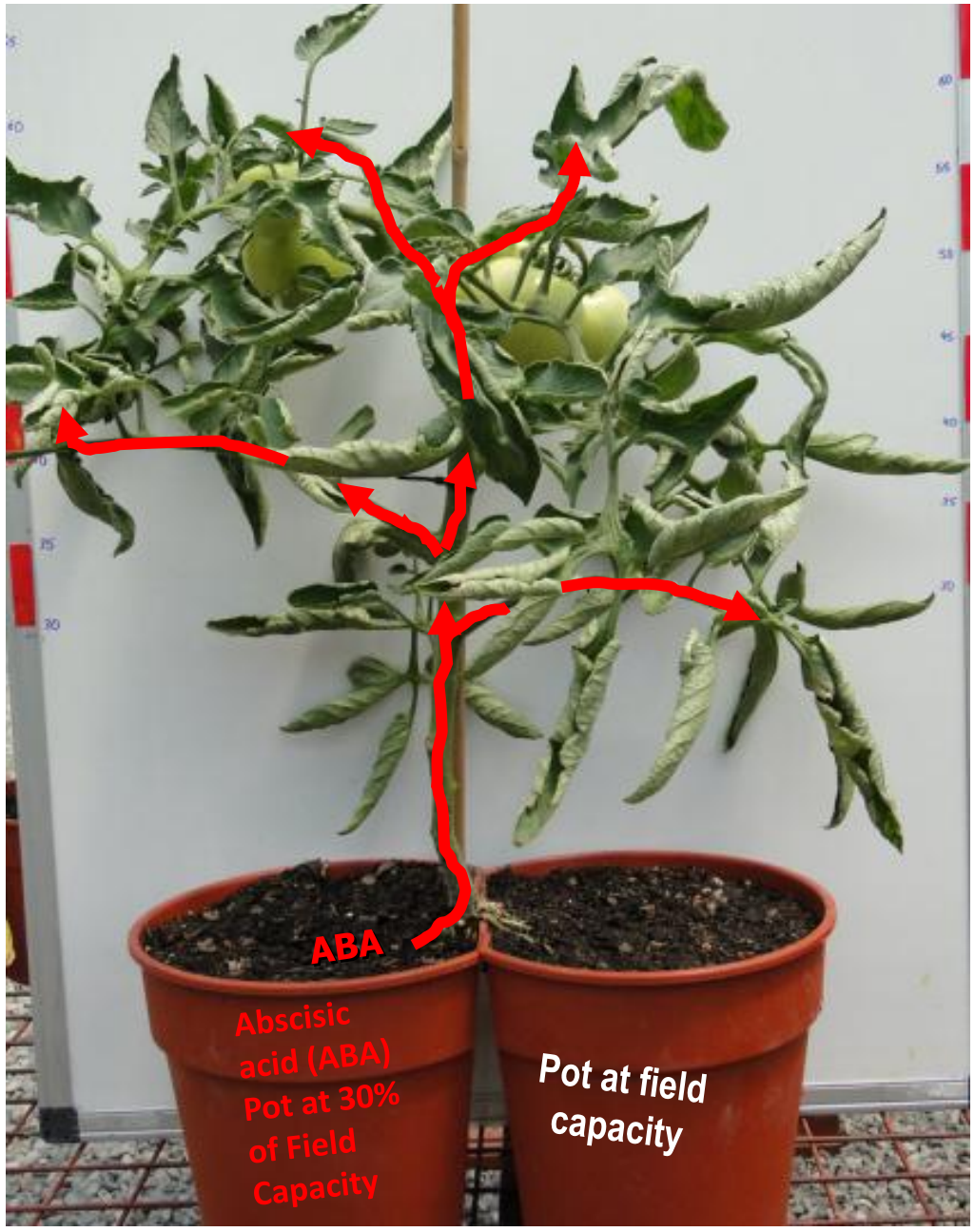
Source: adapted by O. Salgado from A. Azancot


3,5 m
?
3,5 m

The plant reacts to the most detrimental signal, perhaps through a complex system of defence mechanism.

The dry side of the root's rules: The stress signal moves upwards or acropetal from the driest roots – pot – soil area, but the entire plant reacts to the alarm signal.





Open Stomata



ABA

Close Stomata



Source: H. Mendoza 2023 translated by O. Salgado





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"Based on my technical knowledge, hours of reading, papers and empirical experience, I've found that the root of plant resilience lies in the root itself"



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Oscar Salgado 2022



ADRENALINE
OR EPINEPHRINE



ETHYLENE

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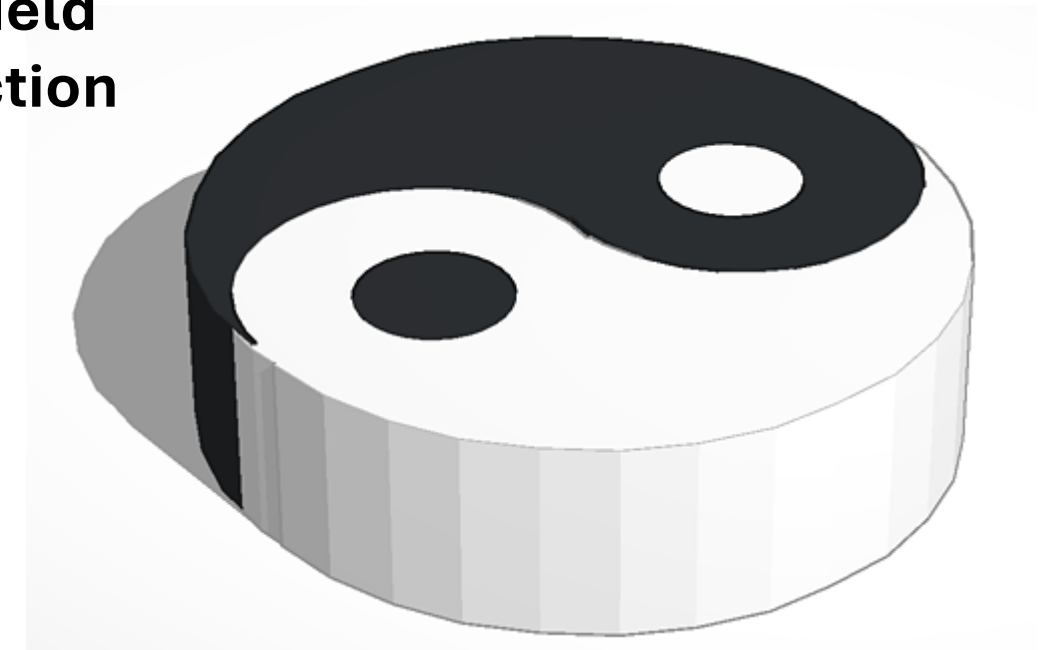
Impact or share between filed production and Post harvest in successful arrivals of Table Grape

50% Field Production



50% Pre & Post harvest

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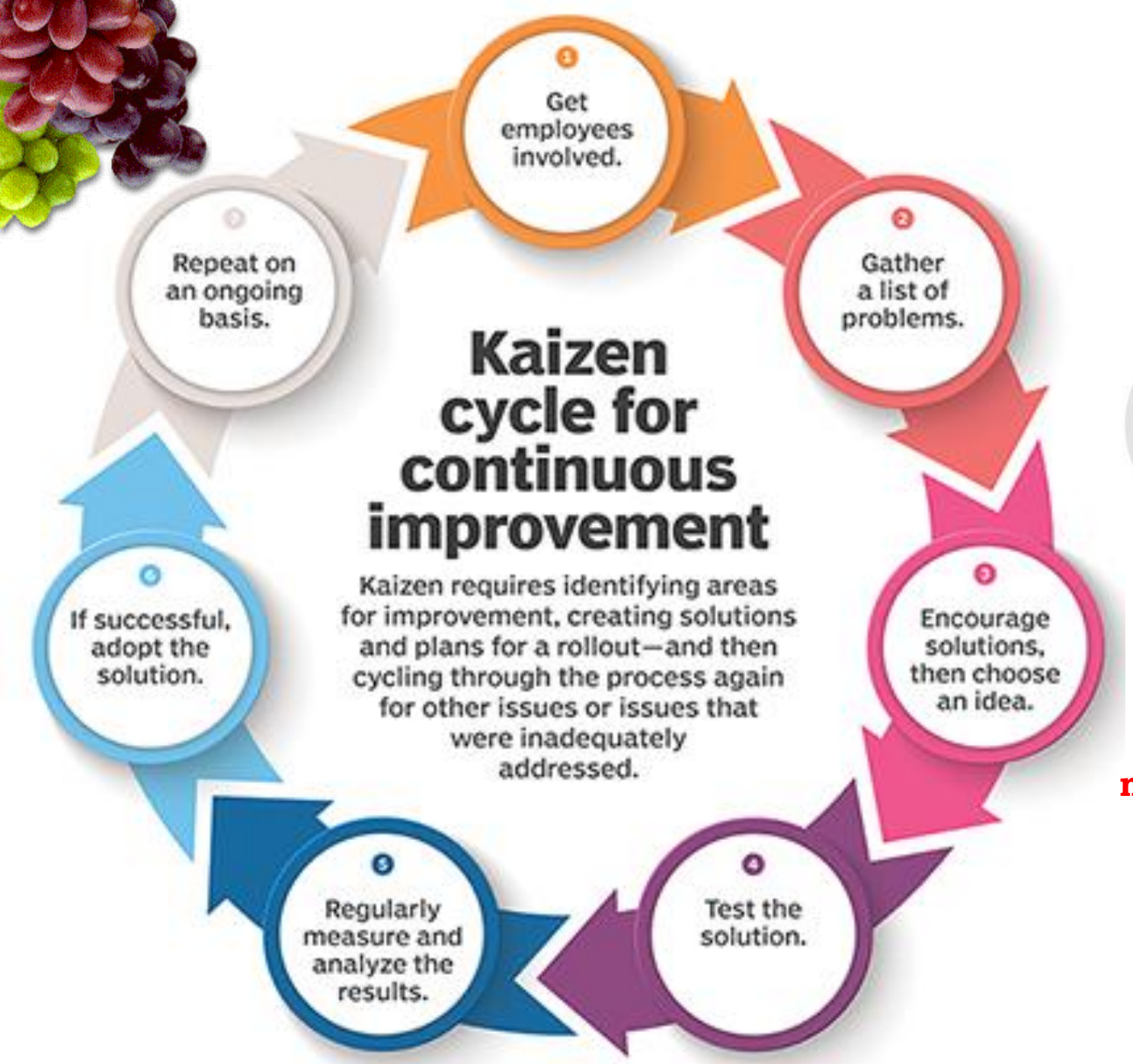
Source: O. Salgado 2011





Change + Better = Continuous improvement

I interpellated all of you: how fare we are moving with the Continues Improvement or Quality Assurance?

https://www.techtarget.com/searcherp/definition/kaizen-or-continuous-improvement

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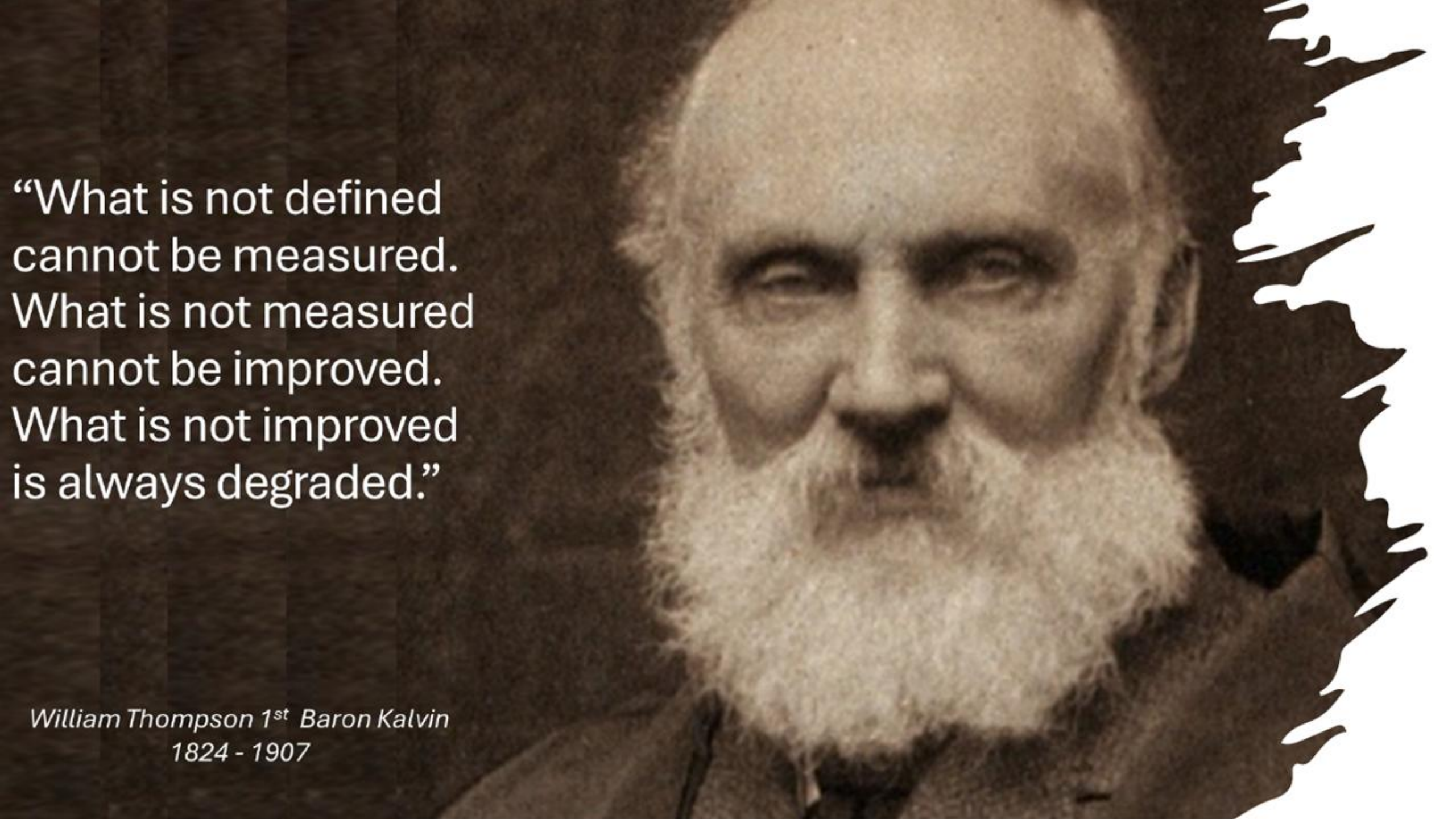
“What is not defined
cannot be measured.
What is not measured
cannot be improved.
What is not improved
is always degraded.”
William Thompson 1st Baron Kalvin
1824 - 1907

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Quality?

Table Grape Quality,

Static attributes that do not change significantly during the normal commercial postharvest period under standard commercial handling :

These attributes are determined at harvest, reflect the combined effects of genotype (cultivar), preharvest growing conditions and vineyard management practices, and remain largely unchanged during the normal commercial postharvest period under standard commercial handling conditions.

- Cluster architecture (cluster conformation)
- Soluble solids content (°Brix)
- Total titratable acidity (%)
- Cluster weight
- Berry weight
- Berry length and equatorial diameter (berry size)
- Berry firmness / texture (crunchiness or crispiness) (?)
- Berry colour
- Cluster conformation (structure)

Source: Practices and standards of the Chilean industry, compiled by O. Salgado, 2006 / 2024

Table Grape Condition,

Dynamic attributes that change significantly during the normal commercial postharvest period under standard commercial handling conditions:

These attributes are associated with fruit senescence and tissue degradation, and their rate of change is influenced by vineyard management practices, These attributes are associated with fruit senescence and tissue degradation, and their rate of change is influenced by vineyard management practices, preharvest and postharvest conditions, cold chain design and management, packaging systems (including liners and box inner dimensions), and logistics management throughout the supply chain.

- Decay (primarily fungal)
- Internal berry breakdown
- External berry breakdown
- Berry shatter
- Microcracking (hairline cracking) / Macrocracking (berry splitting)
- Berry bleaching
- Berry dehydration
- Stem/rachis dehydration / Stem browning (enzymatic oxidation)



Size is also a critical quality attribute in table grapes!



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Vapour Pressure Deficit (VPD)





Understanding Vapour Pressure Deficit (VPD):

The Key to Pre- and Post-Harvest Management of Table Grapes and Fresh Produce

Think of Vapour Pressure Deficit (VPD) as the air's thirst. The thirstier the air, the more water it pulls from the plant.

DPV – Vapour Pressure Deficit

The **air's thirst** for water

What is DPV?

DPV (Vapour Pressure Deficit) is the difference between the amount of water vapour in the air and the amount the air can hold at a given temperature.

High DPV = Dry air

- More evaporation
- Greater water loss
- Plant stress



High DPV increases the water demand of plants, as water evaporates faster from leaves and fruits.

Key DPV values (guideline)

< 1.0 kPa	Low – No stress
1.0 – 1.5 kPa	Moderate – Watch
1.5 – 2.5 kPa	High – Plant stress
> 2.5 kPa	Very high – Severe stress

Low DPV
(Humid air)
Less evaporation
Lower water loss
Plant comfort

Moderate DPV
(Balanced)
Normal stress conditions

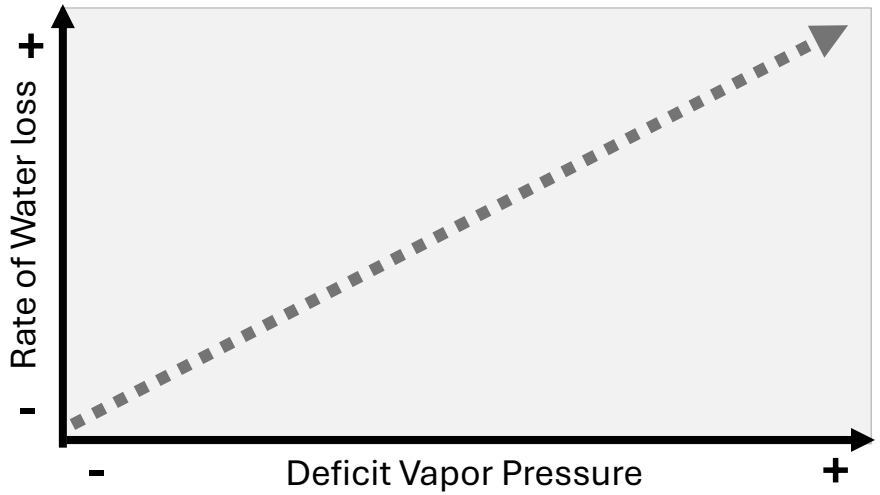
High DPV
(Dry air)
More evaporation
Greater water loss
Plant stress

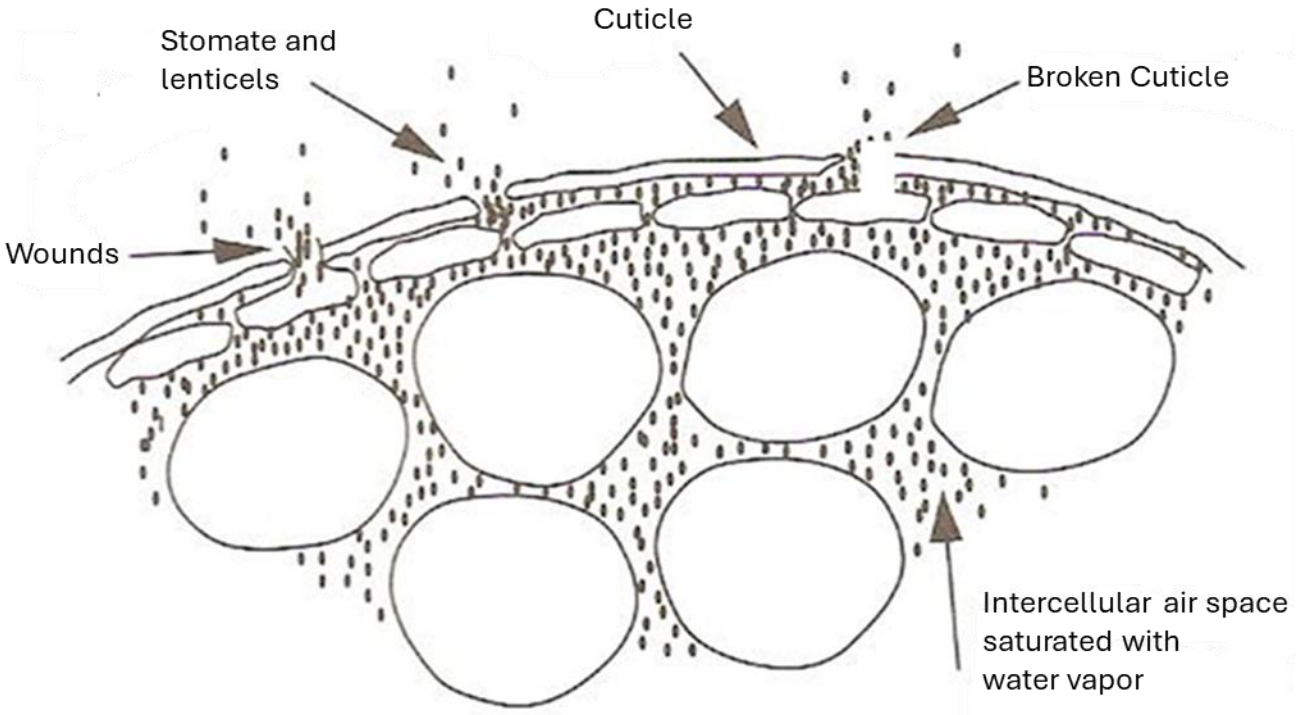
Takeaway: The higher the DPV, the "thirstier" the air — and the greater the risk of water loss and stress for plants and fruits.

Why do we cool fruit and why must it be cooled quickly?

- The primary objective of rapid cooling in table grapes is to minimize water loss by reducing the vapour pressure deficit (VPD) between the fruit tissues and the surrounding atmosphere, thereby maintaining cellular turgor and preserving tissue integrity.
- Reduce pathogen activity, avoid dehydration and condensation.
- Slowdown the phenomenon of senescence

Effect of Vapour Pressure Deficit (VPD) on Moisture Loss Dynamics in Green Tissues of Table Grapes

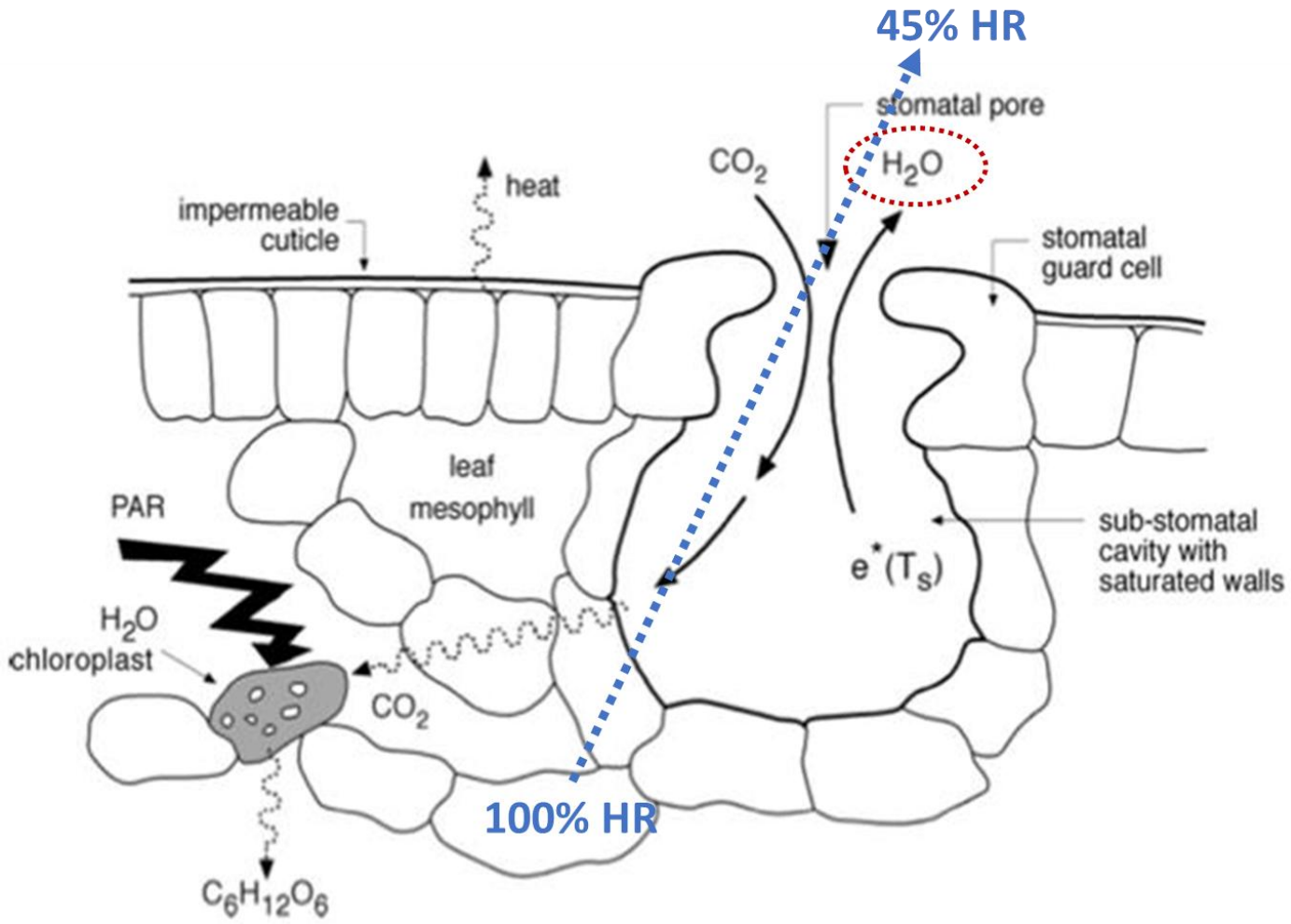




Primary routes of water loss in fresh produce

Source: Mitchell & Kader

The fundamental dilemma of plants and effect of VPD on the Rate of Moisture Loss



Plant tissues require a high cellular water status to maintain turgor, membrane integrity, and normal metabolic activity. However, because the surrounding atmosphere is generally less saturated with water vapour than the internal tissues, water is continuously lost to the environment. This water loss is primarily governed by the vapour pressure deficit (VPD) between the tissue surface and the surrounding air, which provides the driving force for transpiration and subsequent tissue dehydration. In table grapes, transpiration is the predominant mechanism of postharvest water loss from green tissues**, whereas respiration contributes negligibly to changes in tissue water content and is not considered a significant direct driver of dehydration.**



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The devil is in the details



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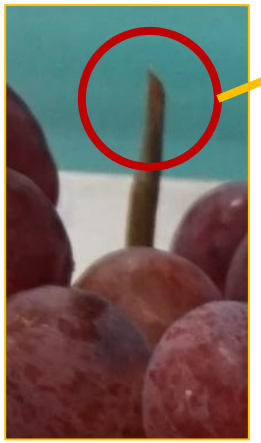





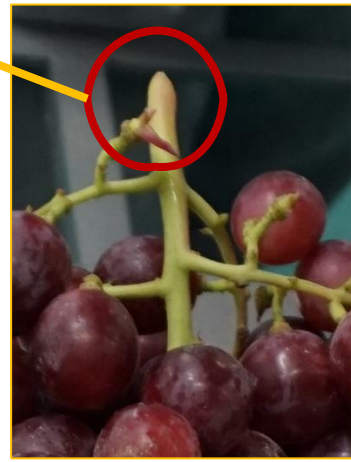



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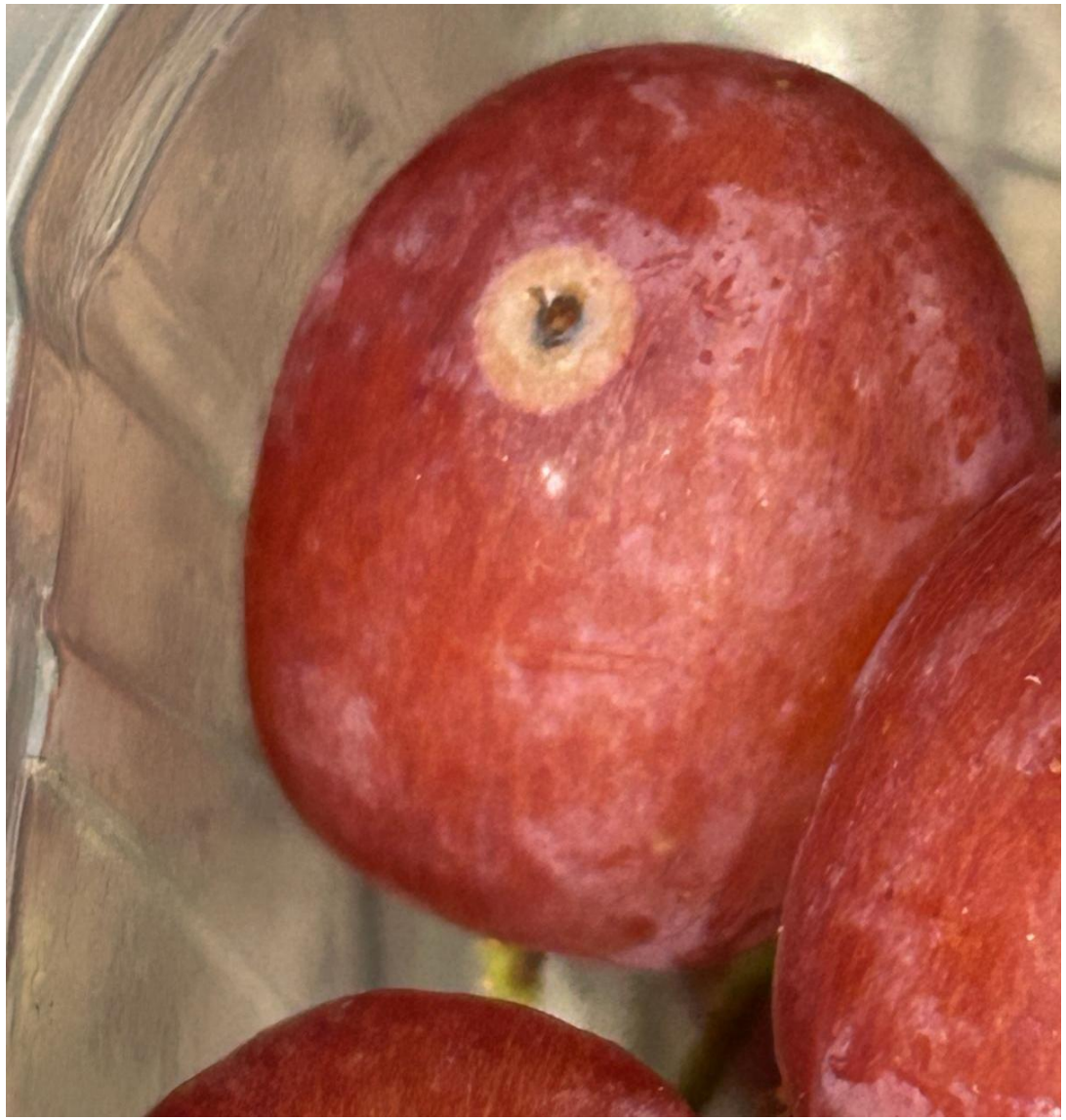
Rally in UK



Red Globe in China





Effect of the use of harvest tray caps in the harvest for a modification of the environmental VPD and its effect on the dehydration of stalks.

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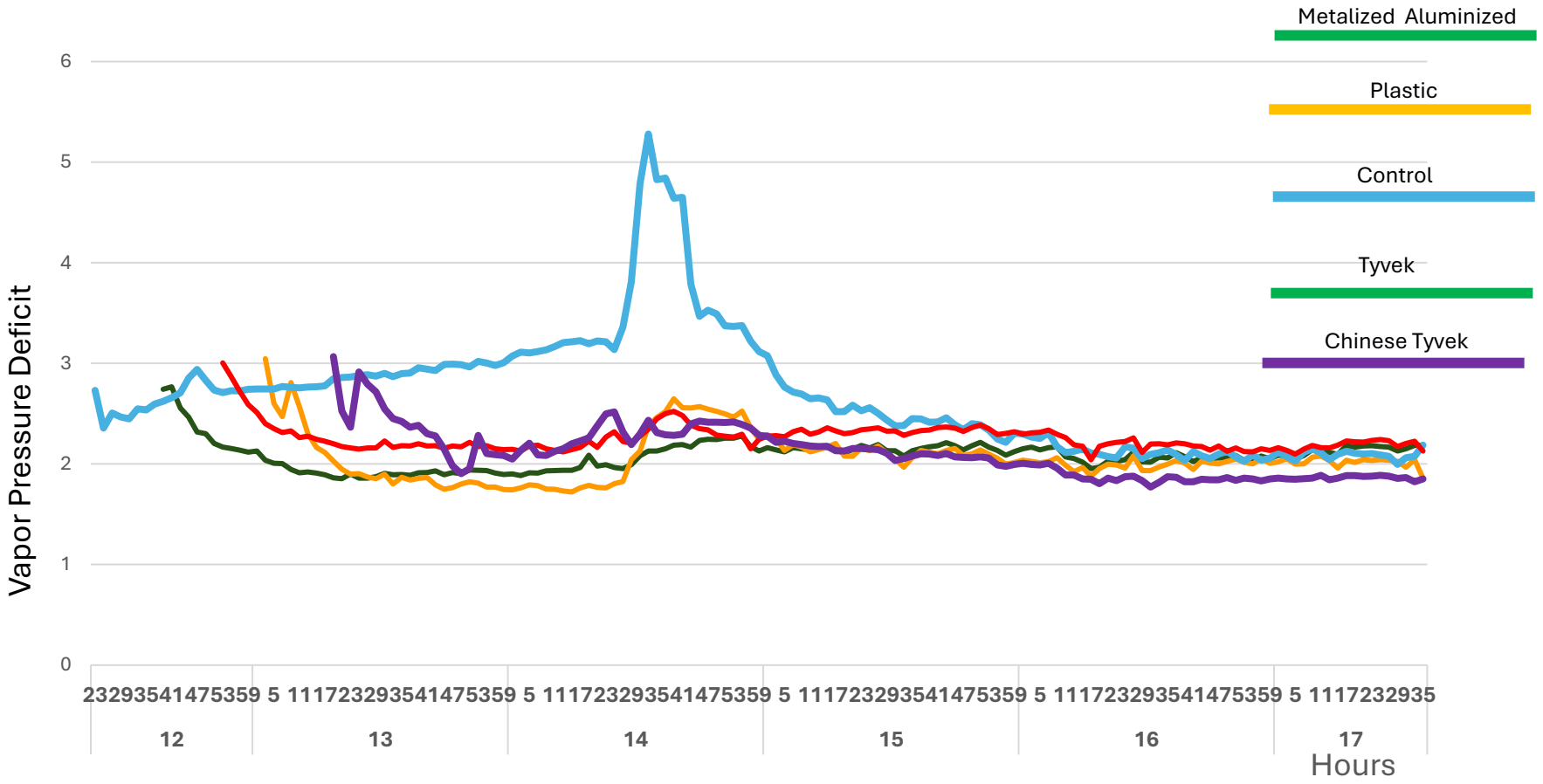
Vapor pressure deficit (VPD)





* Tyvek: Breathable high-density polyethylene, widely used in home thermal insulation and EPP (expanded polypropylene) suits.

Source: RioKing Efecto del uso de capuchones de bandeja en la cosecha para una modificación del DPV ambiental y su efecto en la deshidratación de escobajos.









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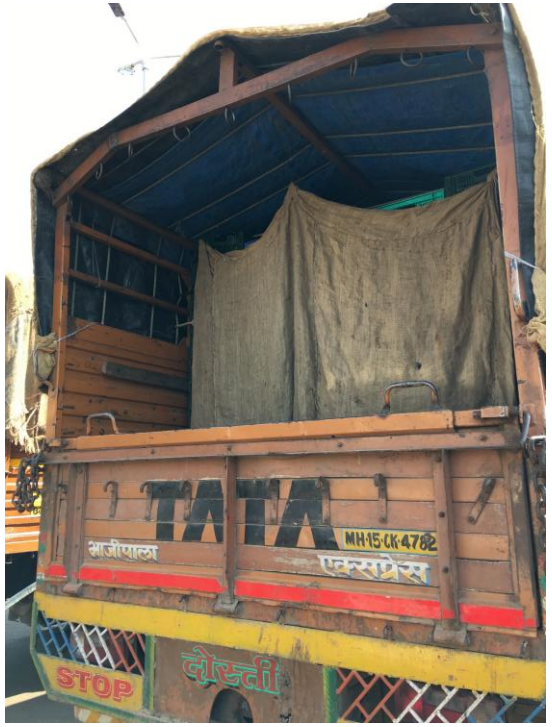
How to keep beer (and drinks) cool in the sun
Sun's heat
Wet cloth absorbs heat
Water evaporates
Cooling by evaporation
1. Cloth gets wet
2. Sun heats the cloth
3. Water evaporates
4. Evaporation takes heat away (latent heat of evaporation)
5. Beverages stay cooler







Raw material reception Area at Sahyadri main packing house, Nashik India





Field loading area with overhead mist, Cerro Prieto in Peru









Mobile loading shade tend in the field and potentially unloading field packed fruit at the cold storage





















Field Loading Shade

•Temporary, movable shade structures positioned according to the harvest blocks.

•Used as a shaded loading area during harvest.

•Can be equipped with overhead misting systems to reduce fruit temperature and minimise dehydration.

•The ground is kept permanently wet to help lower the ambient temperature and reduce dust.




Milk
A Dairy Truck

Pack Life min pallet covers









Semi perforated mini pallet cover, reduce the VPD (Vapor Pressure Deficit) reducing the dehydration ration between harvest until holding precooling room.
By loosing just 2% of weight in some new varieties the result in 10 – 15 days is a moderated to severe stem dehydration.

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2 drip lines
Should cover till the pallet base








T6N847
DEFRUSA
DEFRUSA
DEFRUSA
DEFRUSA
DEFRUSA
CAT
CAT







Pack Life min pallet covers


CAT

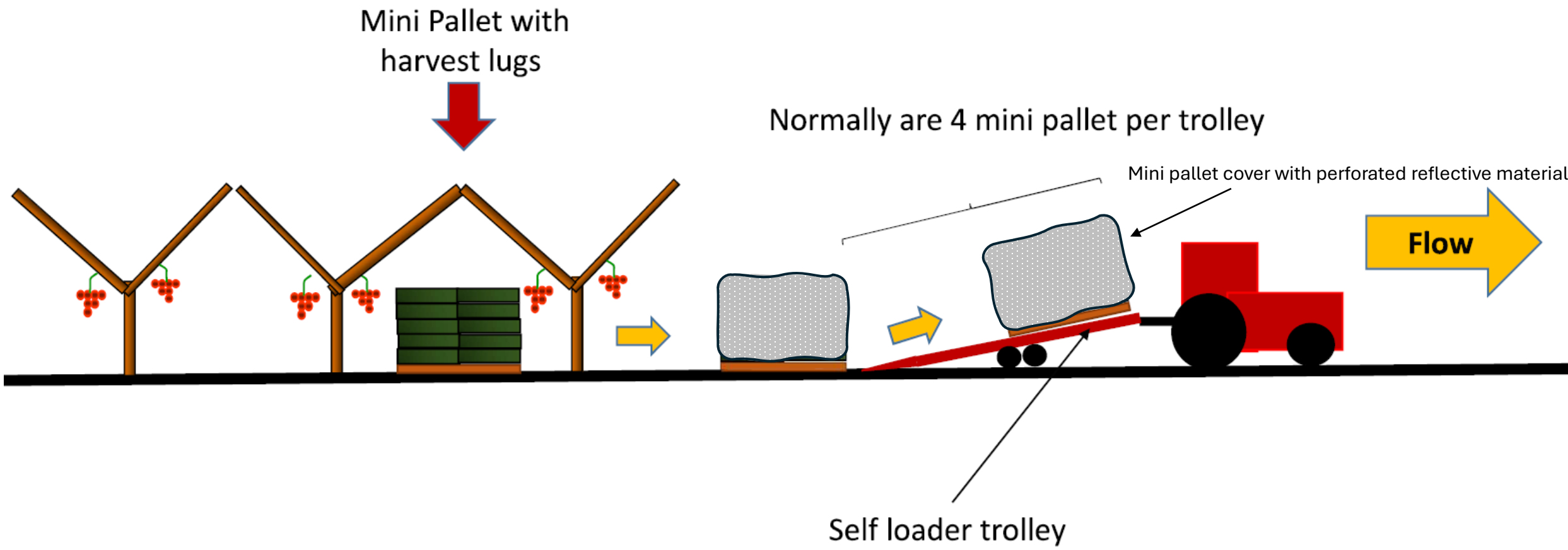

H100




CAT
T3R817

Proposal

Flow of the harvest



Proposal: field loading areas

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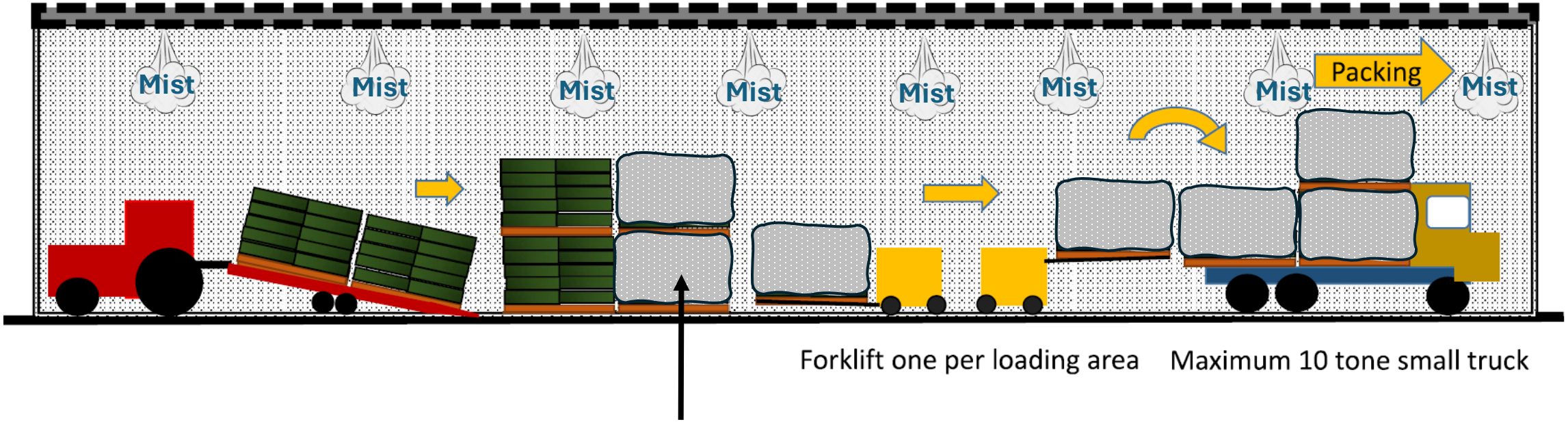
Field Loading shed area as close as possible of the orchard, this structure should be able to move it, from area to area, perhaps 3 units, will give room to move it before the harvest of each sector.
Shadow black net 40 – 50% shadow
The distribution of those loading areas are strategic to reduce the time to expose the fruit.



South Africa



Jalisco Mexico



South Africa



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South Africa








SMOKING
IN DEMARCATED
AREAS ONLY

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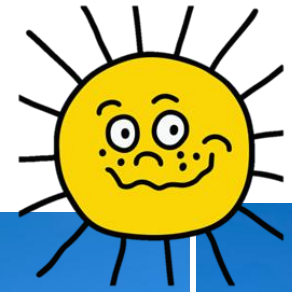
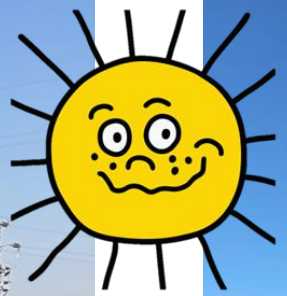



PRECOOLER




CHEVROLET



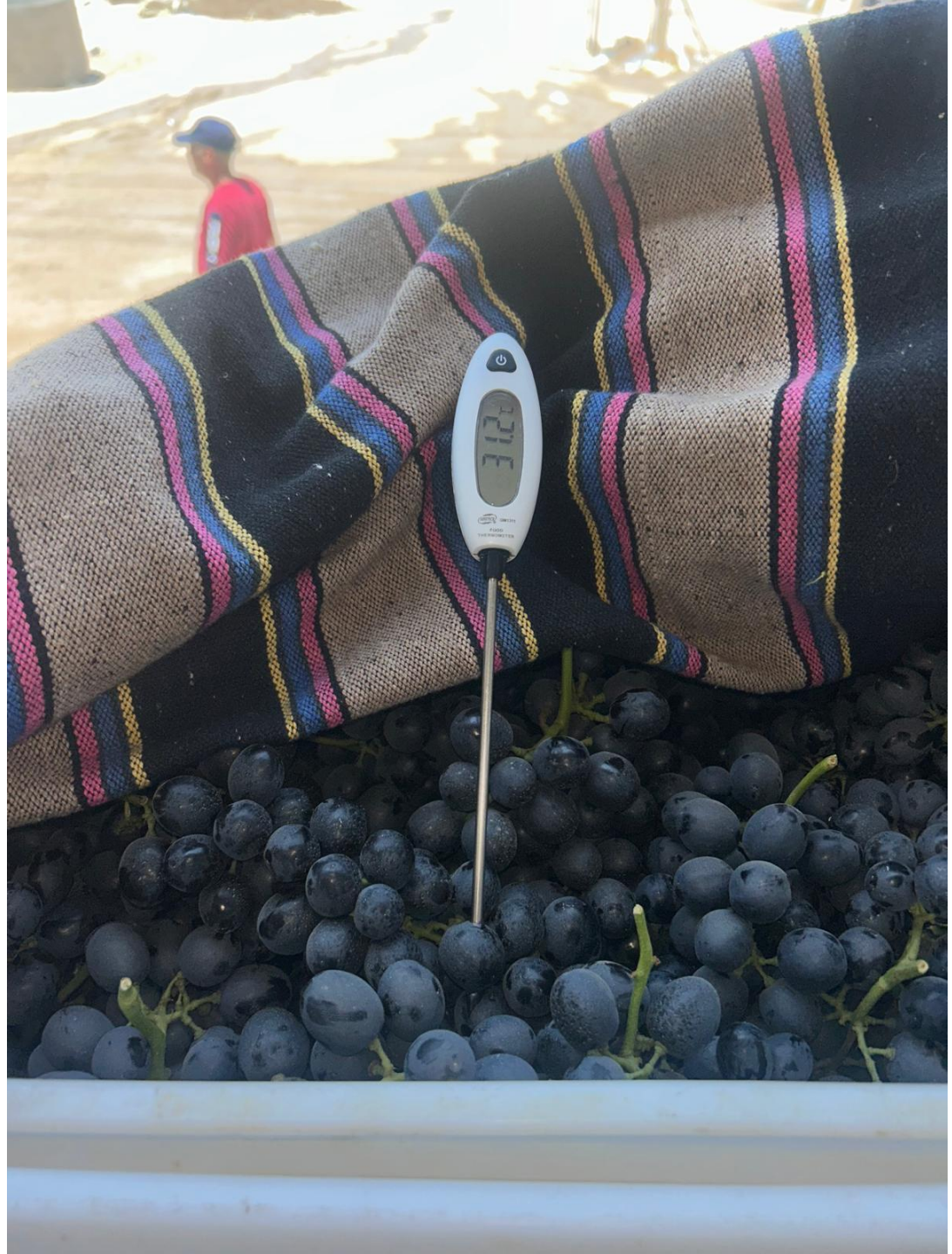








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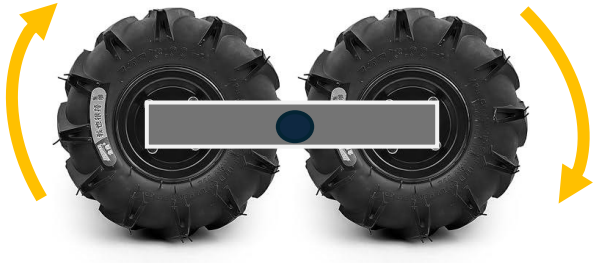




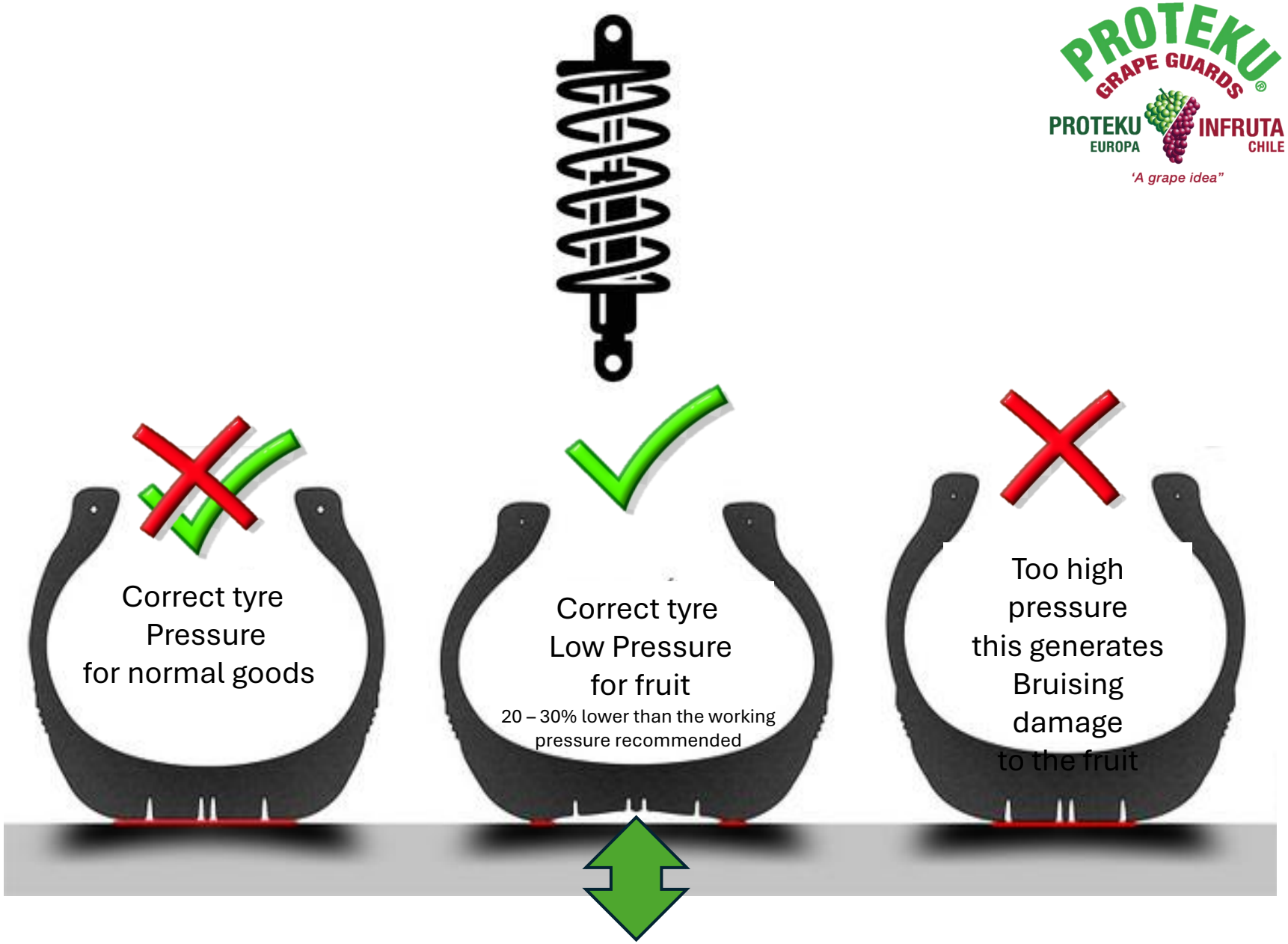


Is the real solution?



Harvest trolley used in most farms in South Africa, seems too high tire pressure





Tyre should be like that at 14:00 pm
every day of the harvest on any vehicle/tractor / trolley that moves fruit.



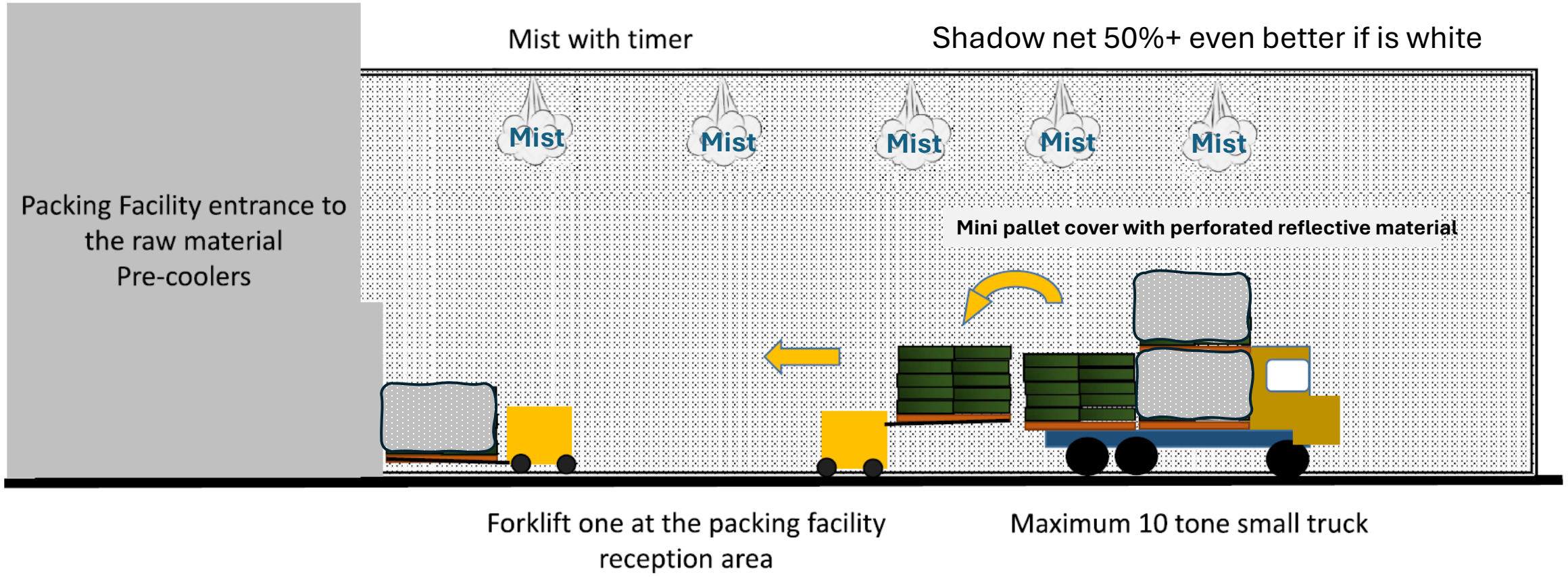
Harvest lugs are often handled roughly, receiving multiple impacts: from harvest to the field truck, from the truck to a pallet, and from the pallet to the packing-line conveyor.
This process can be automated by placing harvest lugs directly onto pallets in the field. The pallets are then moved throughout the operation using forklifts or pallet jacks, reducing handling to a single transfer, minimizing impacts, and improving labour efficiency and productivity.





Proposal: at the arrival of the Packing facility unloading areas

Unloading area at the packing facility, even if there are a metal roof, mist are equally important
Target 70%. RH





Destroy the paradigm

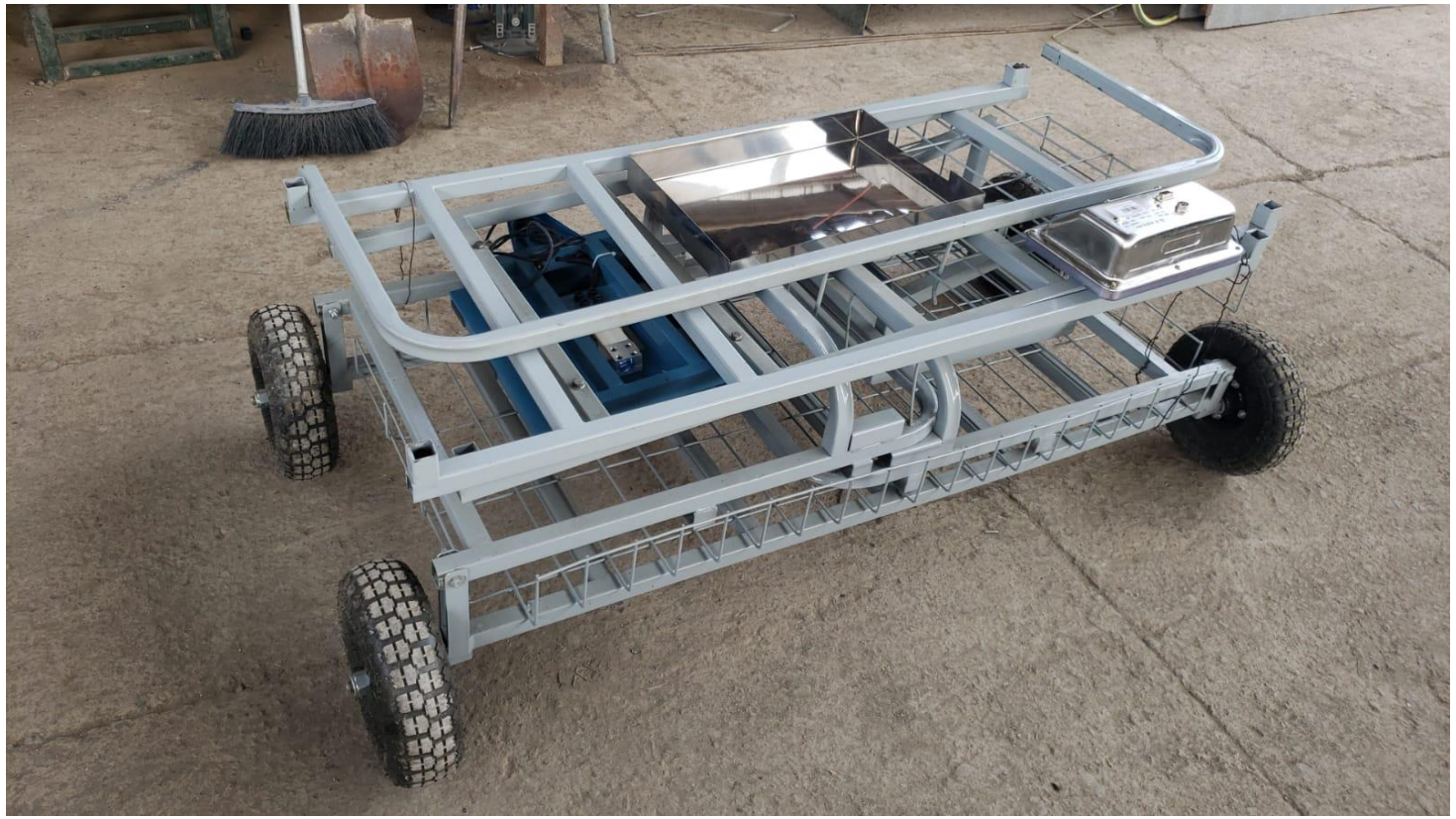





TABLE GRAPES








Lot 29

Perforaciones para el colgador de las bolsas uveras / **Perforations for the table grape bag hanger**

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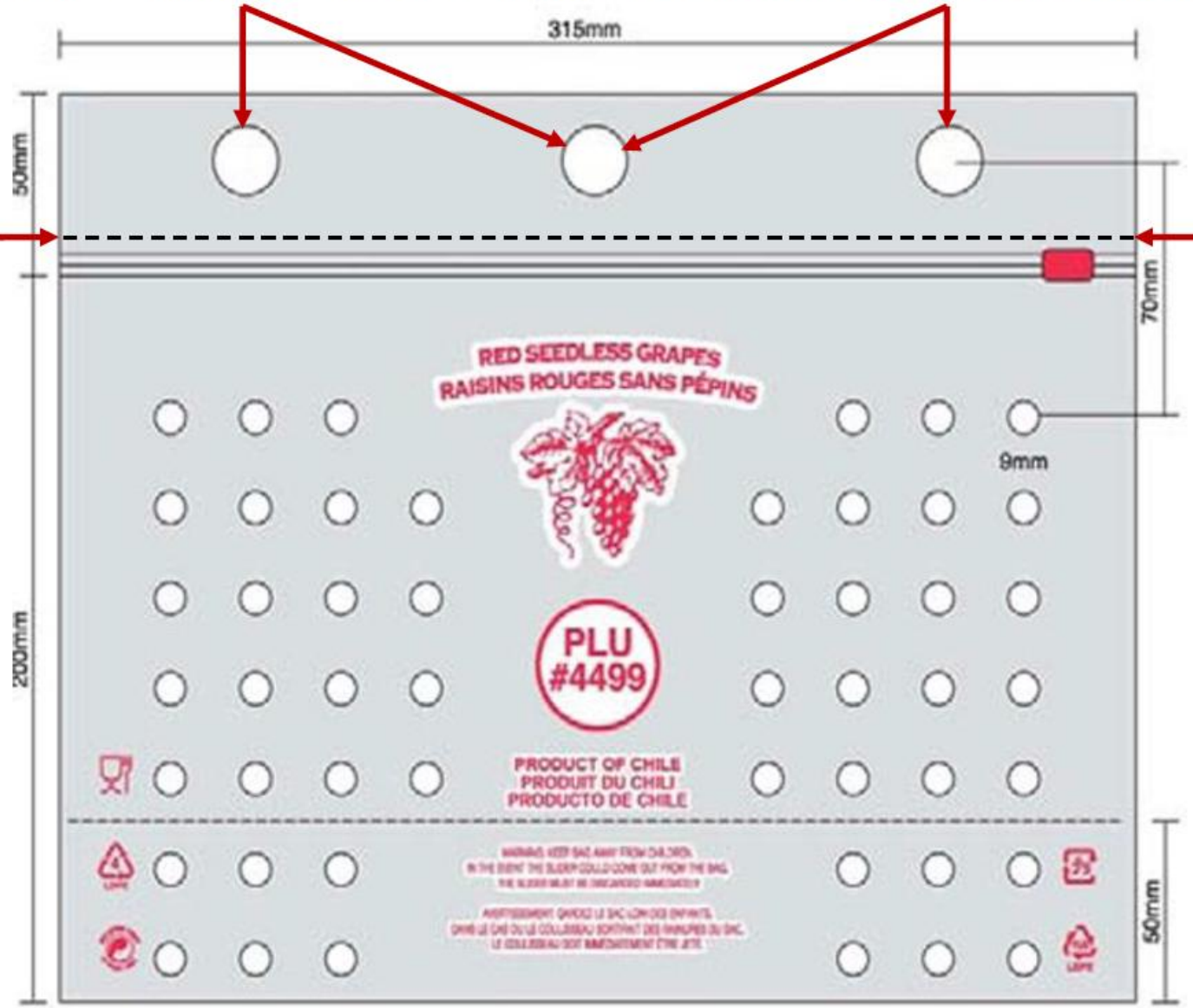
Precut for tear-off The bag

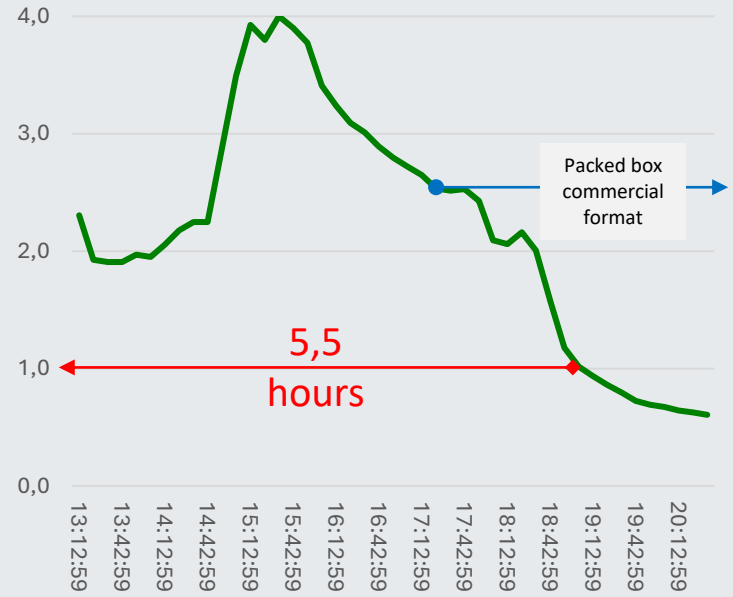
Pre- cortado para arrancar La bolsa



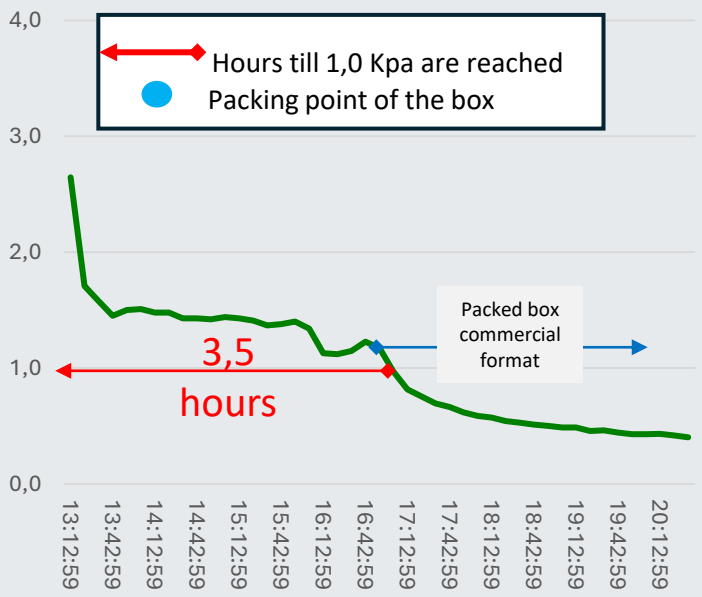
Different VPD in different harvest and packing techniques

VPD (Kpa) Traditional Packing

With out lug covering
(standard harvest and centralize packing traditionally done in Chile)



With lug covering
(Plastic lug protection "Shower cup")

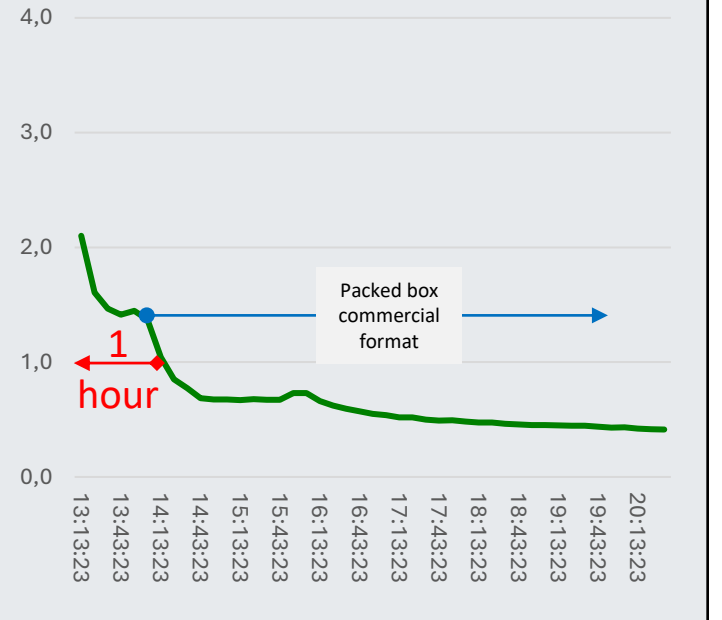






VPD (Kpa) Field Packing

Filed packing operation
(with plastic liner and SO2 Sheet)







Source: Adapted from O . Salgado from Rio King December 2023, large Chilean exporters, summary from the USA Market, Infruta and Proteku Webinar December 2023, "Dehydration in table Grap



Destroy the paradigm, night harvest in Ica




PROCOM SAC 2023





Right tools:
Recommended Scissors for Thinning / cluster preparation, harvest and cleaning at the filed or packing house



www.arscorporation.jp/es/product/detail-index.html?id=75



www.arscorporation.jp/es/product/detail-index.html?id=80



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Inner 5 side inner plastic lugs protection, this protection allow to wash the box are tied to the lugs and allow the precooling of the raw material as well as the SO2 fumigation in SO2 Chambers. Peru 2023 and 2024












Black attract the heat















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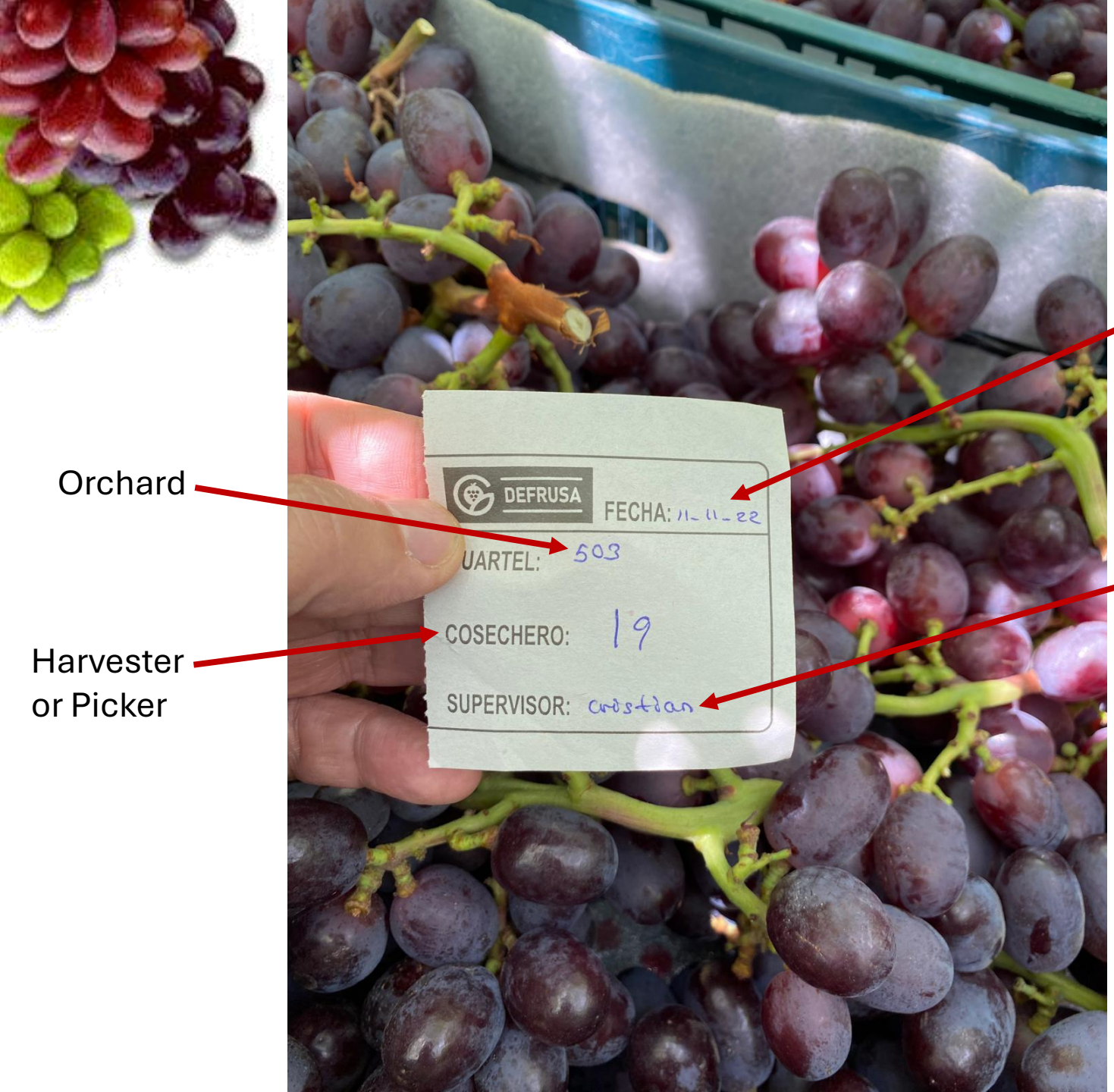


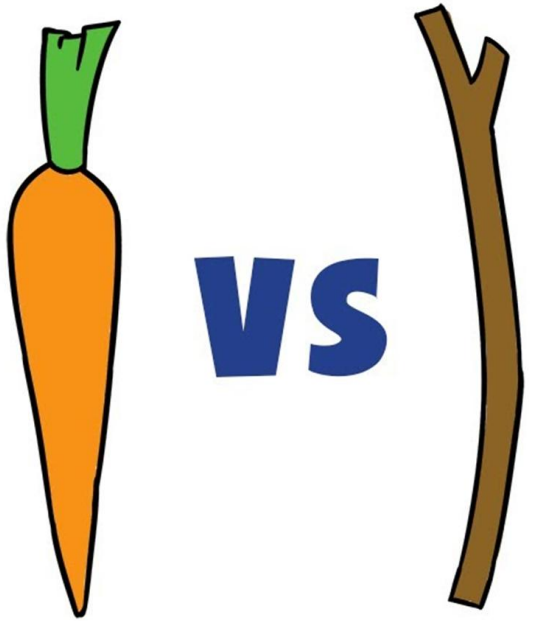
Orchard

Harvester or Picker

Date

Supervisor







Placement for the bunches sideways and single layer of bunches with no empty spaces to reduce he vibration.

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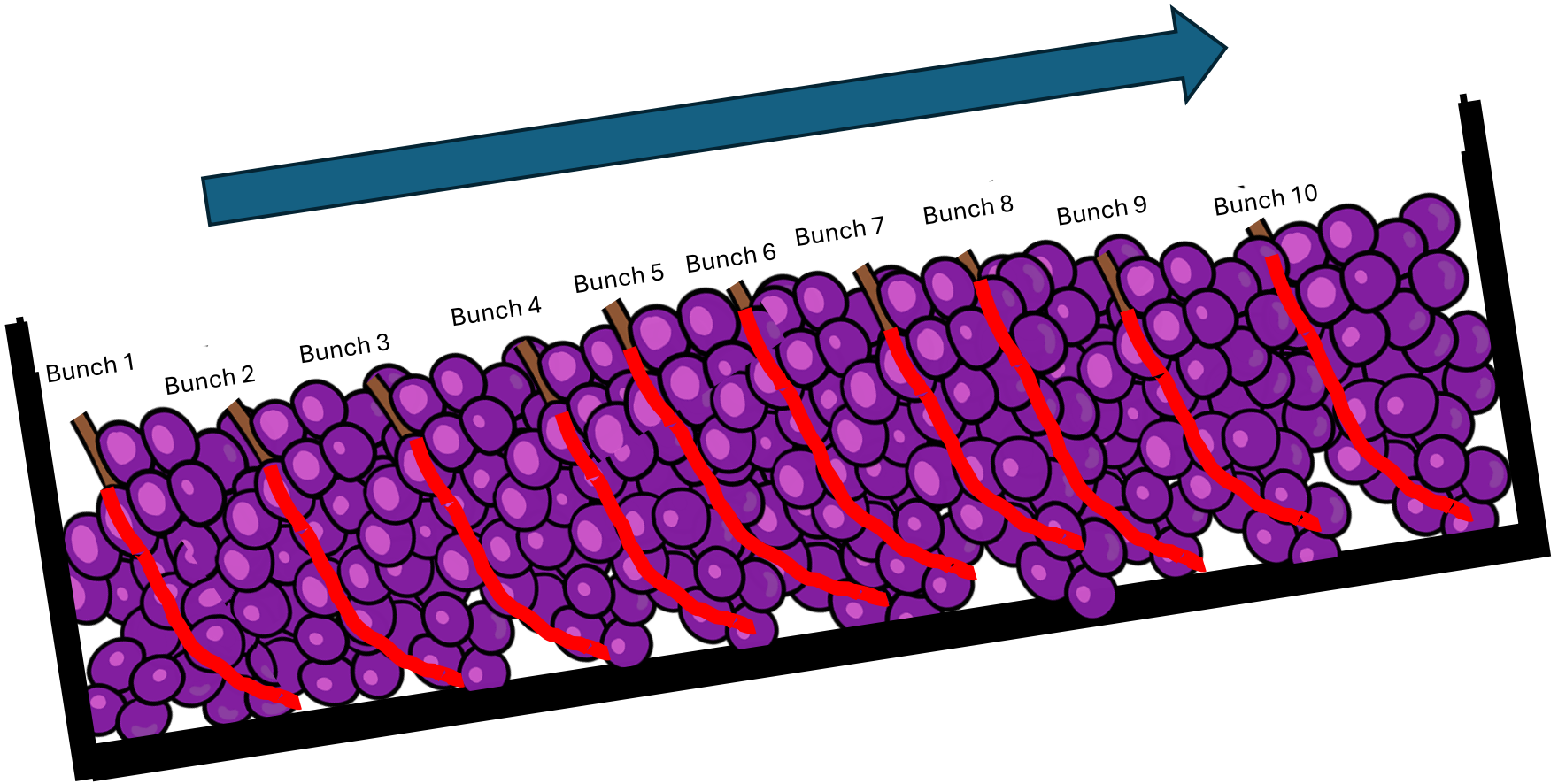





Harvest crate stand









Chile and/ y Peru

Objective:

•Reduce excessive handling and bruising of grape bunches by placing them in an easy and gentle manner.

•Minimize unnecessary heavy labour by enabling a more ergonomic workflow.

•The lectern should be robust, yet very lightweight and easy to transport.






AGROKASA 13
AGROKASA



Field cleaning Stand frame and inner harvest lug protection





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South Africa, give a thought about this.....



https://www.adagintech.com/solutions/

Lerida, Spain

2020





Harvest, cleaning and field debag packing for store
(stored 60 – 70 days CRM Lerida).

2019

(Pictures: O. Salgado 2019 / 20)



ADR



Light trolley

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The manual harvest trolley should be lightweight, robust and easy to repair. Wheel type should be selected according to the field conditions (e.g. stony or very sandy soils). The front swivel castors should rotate freely through 360°, allowing the trolley to turn within its own footprint and improving **manoeuvrability between vine rows.**



Field
Cleaning
trimming for
packing








Light trolley ??

A single wheel makes the stand unstable and difficult to manoeuvre, increasing the risk of berry shatter. Adequate internal protection of the harvest crate is essential.







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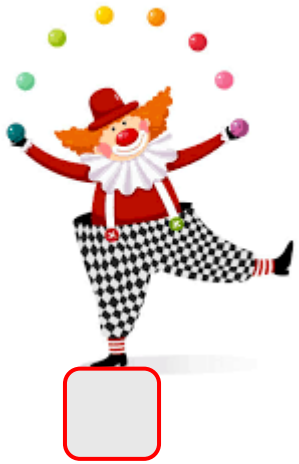
Egypt





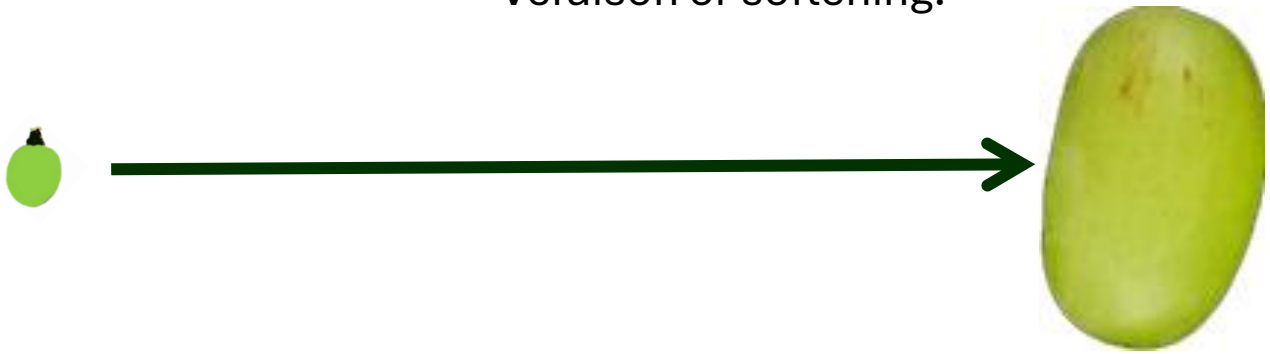
Where is the wax or bloom?

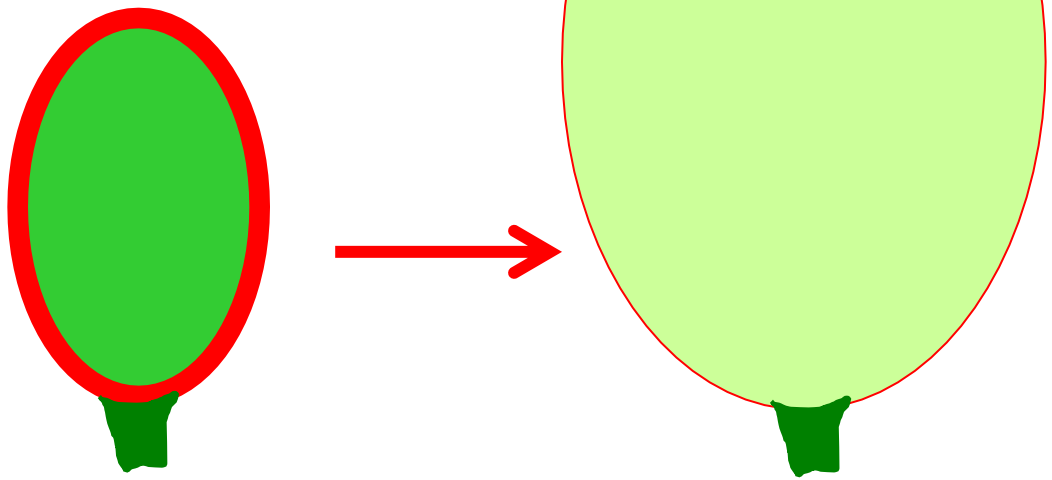






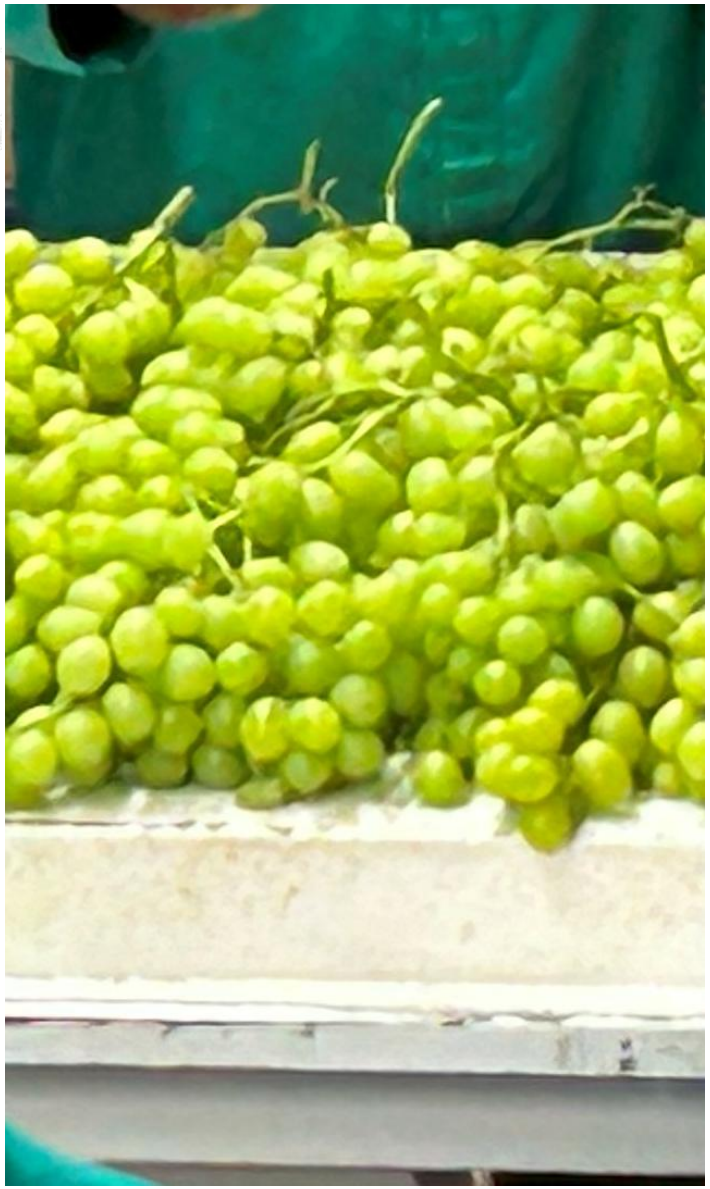
Cutin per unit area decreases more than 2.5 times between the setting and the Veraison or softening.





"SAME AMOUNT OF WAX PER BERRY AT PEA-SIZE AND MATURITY"

Source: From H. Mendoza compiled from Wendy Mc Fadden-Smith Tender Fruit & Grape IPM Specialist





Too many bunches are stacked on top of each other. As a result, the berries rub against one another, removing the natural bloom (wax), the fruit's first line of defence against decay. In some cases, there are two or even three layers of bunches, leading to bruising and increased berry shatter.





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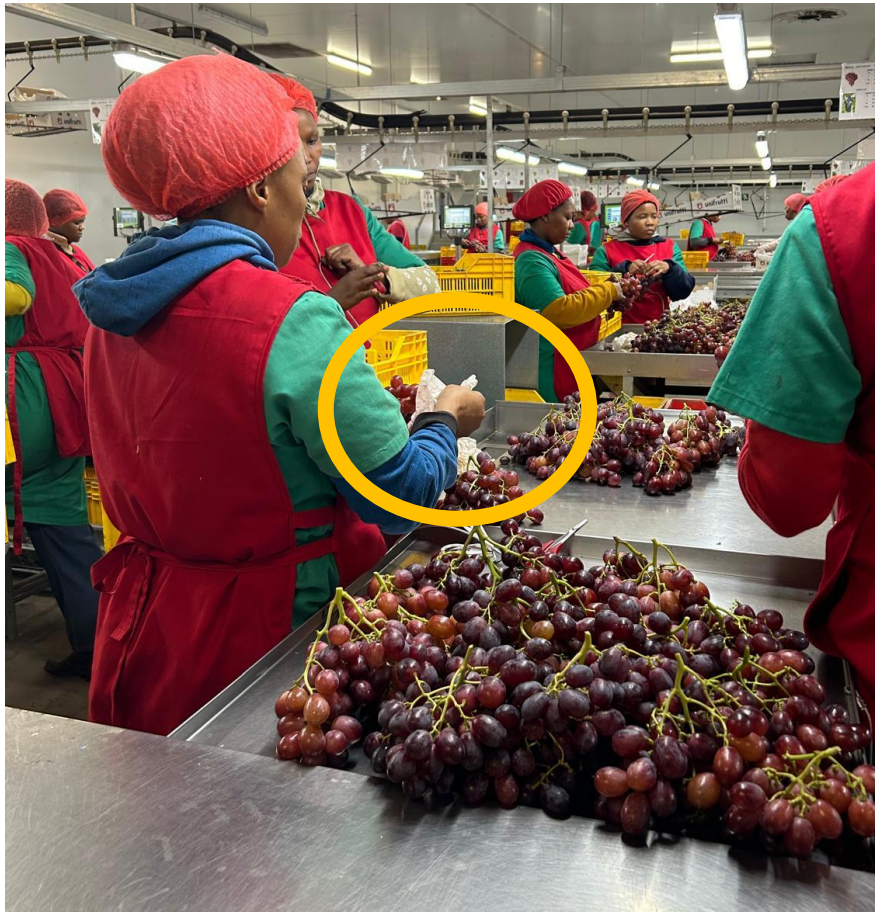
How can light dust be removed without causing further damage?













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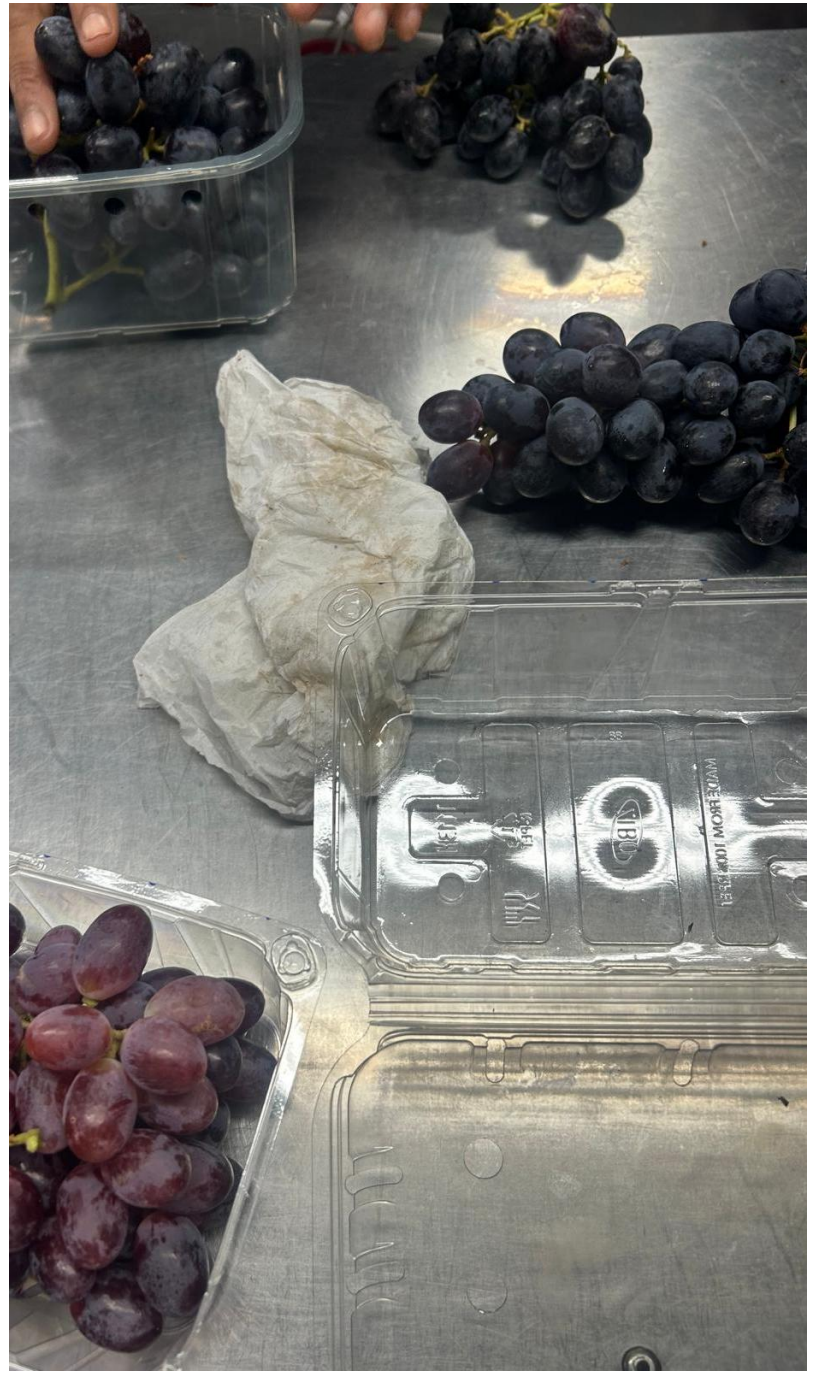





No ventilation at the side of the box, for the raw material precooling





Relative humidity.....40% or lower

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Examples for table grape growers:

•**Copiapó Valley, Chile (upper valley, dry summer conditions):** Ambient temperature **35°C** and **25% RH** → the air leaving the evaporative cooler may be around **20°C**, providing approximately **15°C** of cooling.
•**Hex River Valley, South Africa (following a summer rainfall):** Ambient temperature **35°C** and **60% RH** → the air leaving the cooler may be around **27°C**, providing approximately **8°C** of cooling.
•**Petrolina, Brazil (following a summer rainfall):** Ambient temperature **35°C** and **70% RH** → the air leaving the cooler may be around **29°C**, providing approximately **6°C** of cooling.
•**Piura, Peru (high humidity conditions):** Ambient temperature **35°C** and **80% RH** → the air leaving the cooler may only reach about **31°C**, providing only **4°C** of cooling.

Key message: *The same evaporative cooling system can reduce air temperature by approximately **15°C** under hot, dry conditions, but by only **8°C**, **6°C**, or even **4°C** as relative humidity increases. The cooling performance depends primarily on the psychrometric properties of the air, especially relative humidity, rather than on the cooling system itself.*

Pre-cooling of raw materials in South Africa with water-coolers, but one of the sides of the harvest lugs is solid, how is it pre-cooled then? Precooling or draying stems?









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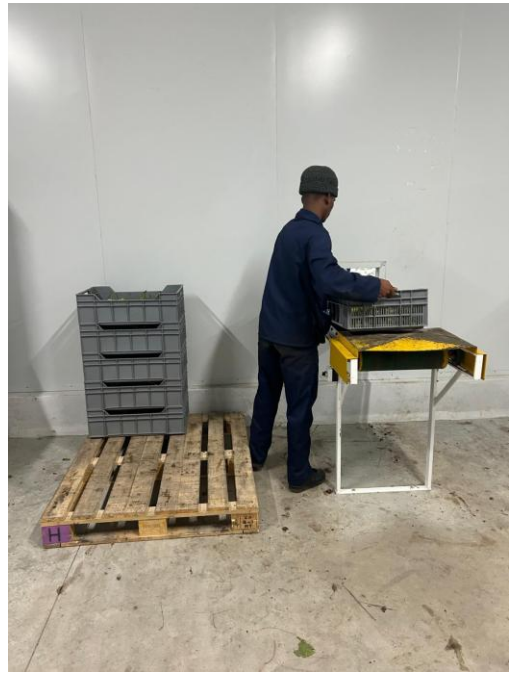


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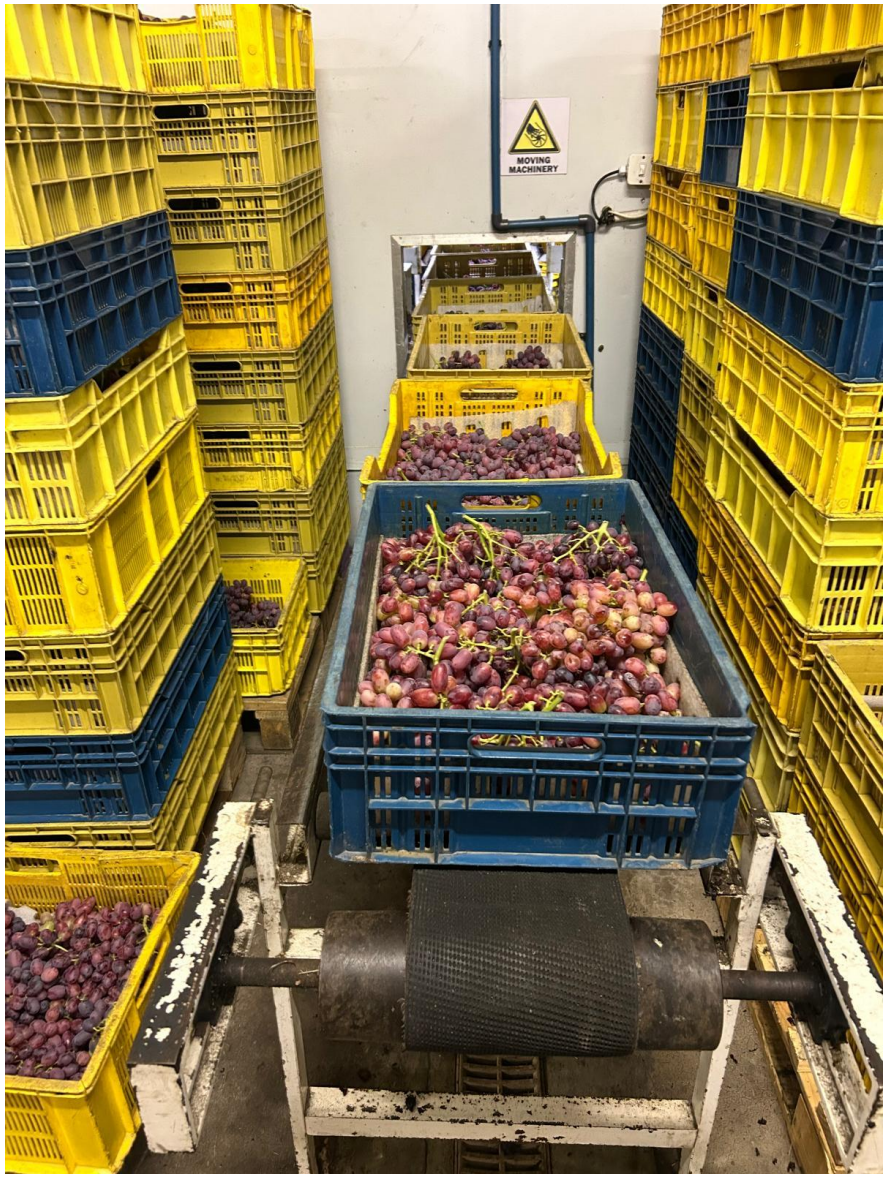
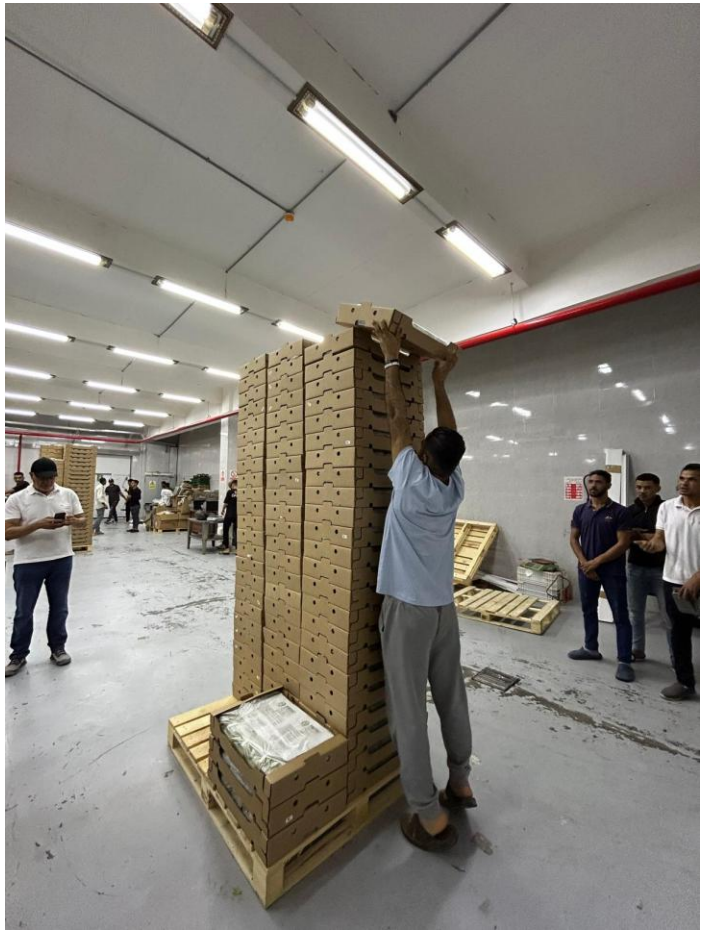
STEENEBRUG


MOVING
MACHINERY

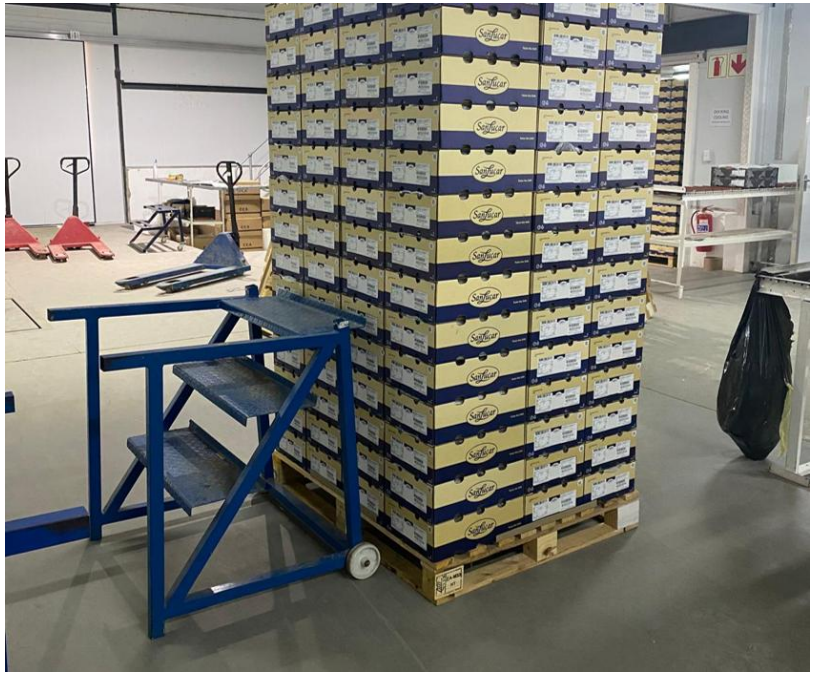

CLASS 1












DUST
BIN

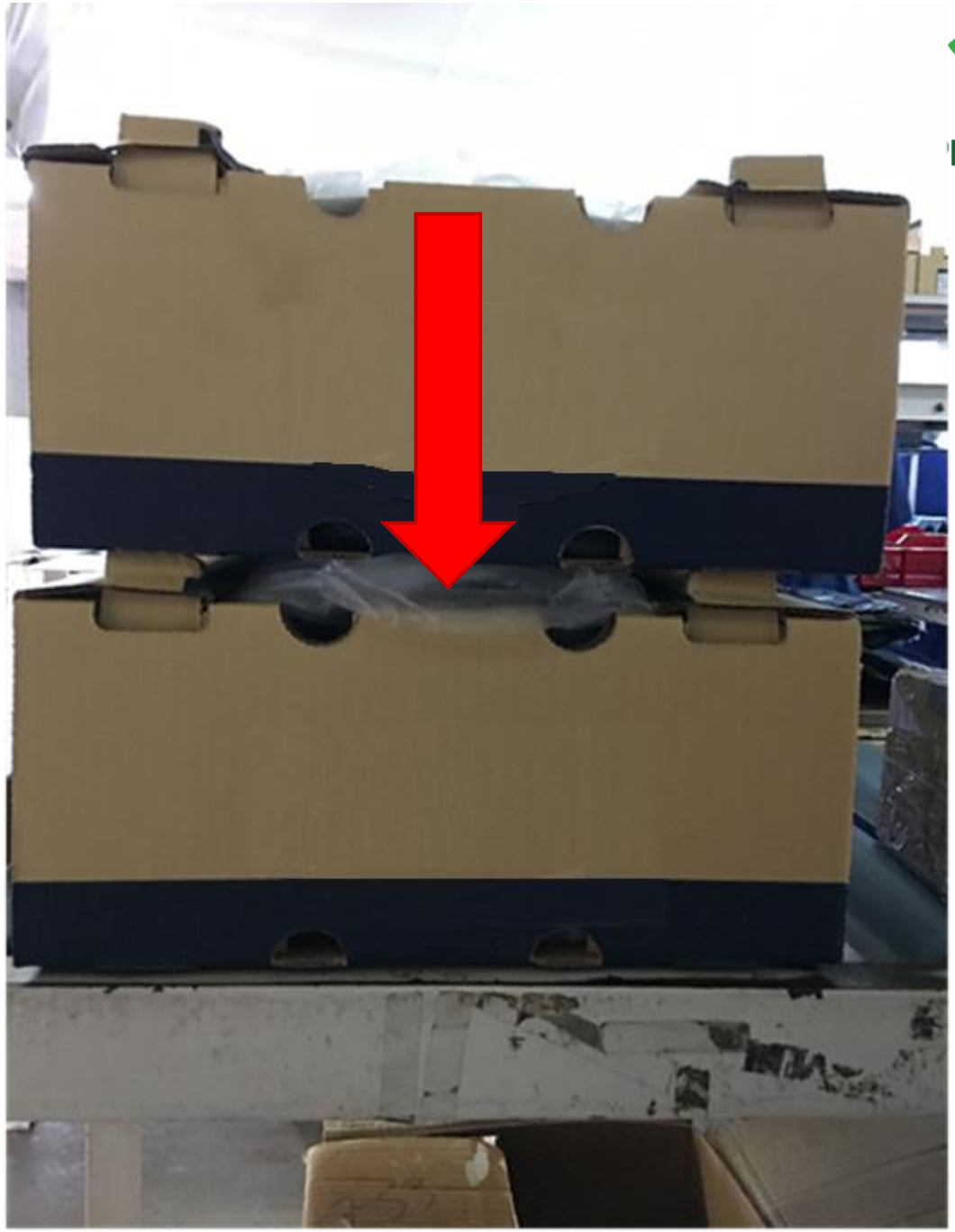



ECOSAC 2022


ECOSAC 2022







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QC Box



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All packers right – hand



Flow of the work from left to right

South Africa:
Easy or make it difficult?
With this operation are an increase of shattering, bruising, pedicel cap- stem tear, removal of the bloom or natural wax, wounds and a slow operation.
9% of the of the female population are left handled





Peru:
Easy or make it difficult?
With this operation are an increase of shattering, bruising, pedicel cap- stem tear, removal of the bloom or natural wax, wounds and a slow operation.

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Packaging table ergonomics
Ergonomics
Stock of butter paper , SO2 pads y absorber pads
Lugs Loose berries waste
Sealing stickers to seal the plastic liner
Poly Bags or pouch metal holder
Packed box
Shattering and Loss berries receiving box
Empty Space
Box already weight and ready to be pack
Liners bags hanger
ACOGRAPES
CAT 1







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CaDiMe
Chaska
TABLE GRAPES


CHILEAN PRODUCT
TABLE GRAPES
CAT 1




ALTO ELQUI

AgroFresh



Fuente: Ing. Agr. V. Vesely PiJ 2024 / vvesely@pij.cl



PiJ
PROYECTOS INDUSTRIALES
JOHNSON





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VDP

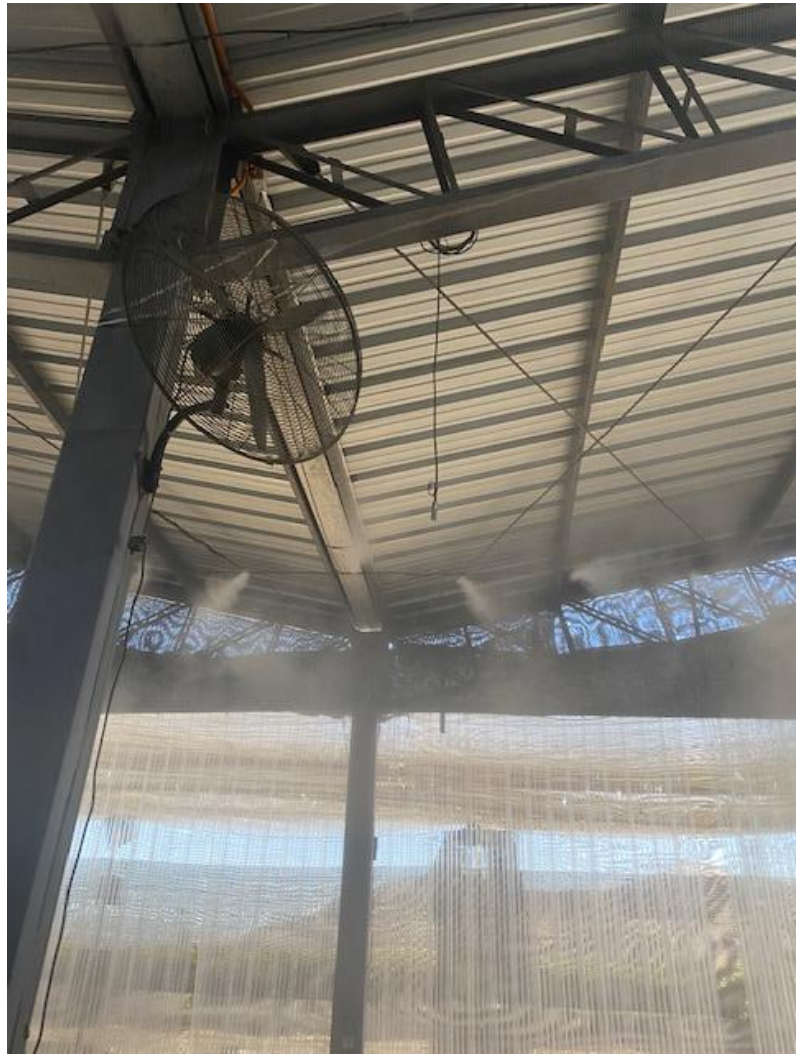
Water Vapor Deficit Pressure





Sensor, activates spray / Mist at a defined point, in this case when reaching below 70% RH



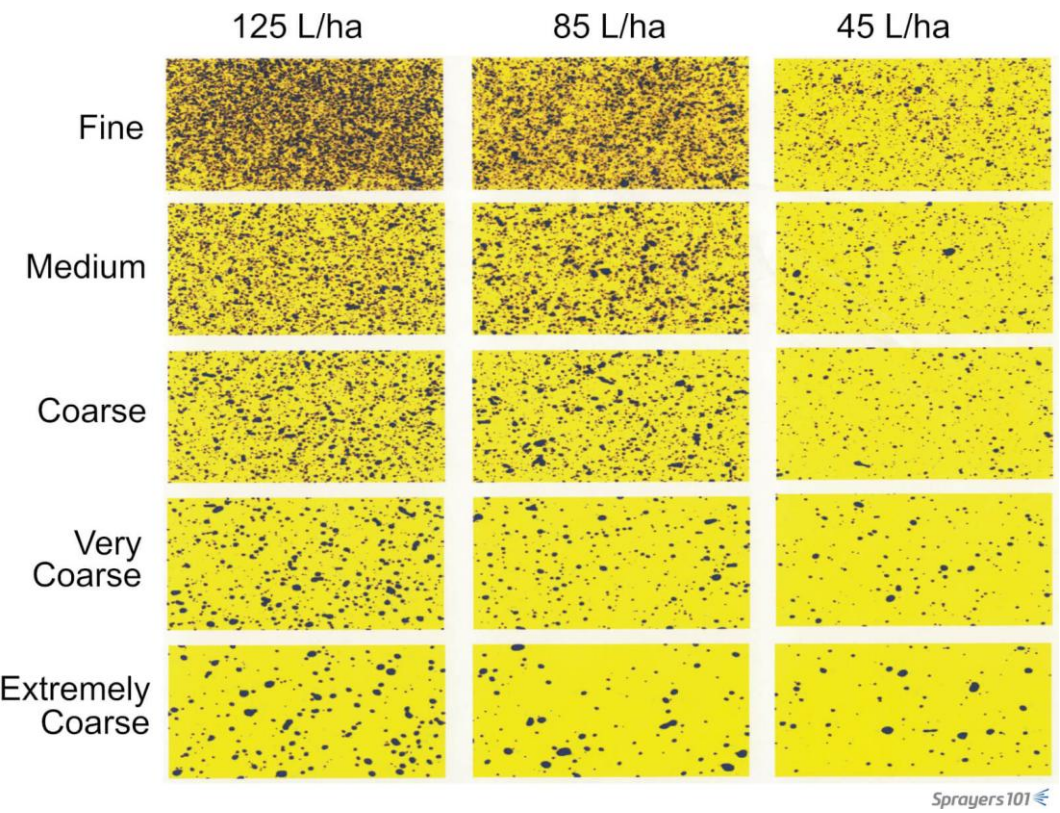














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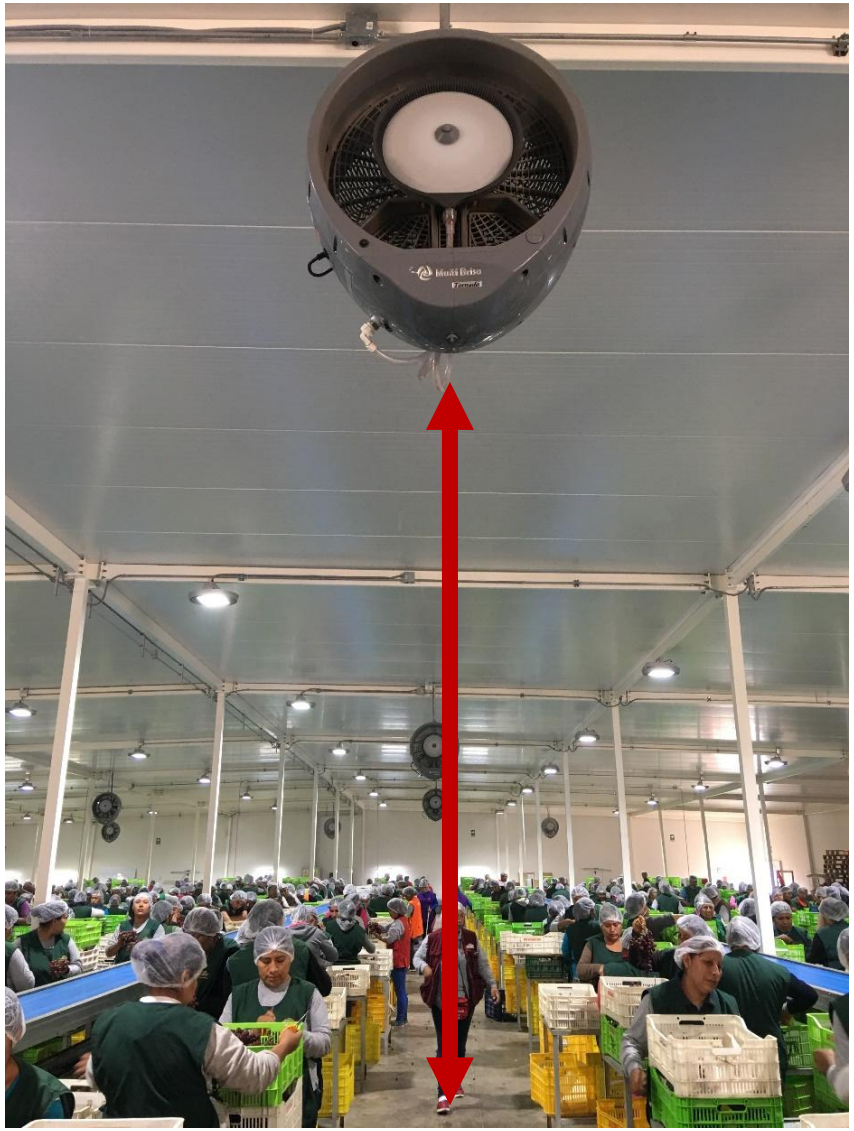
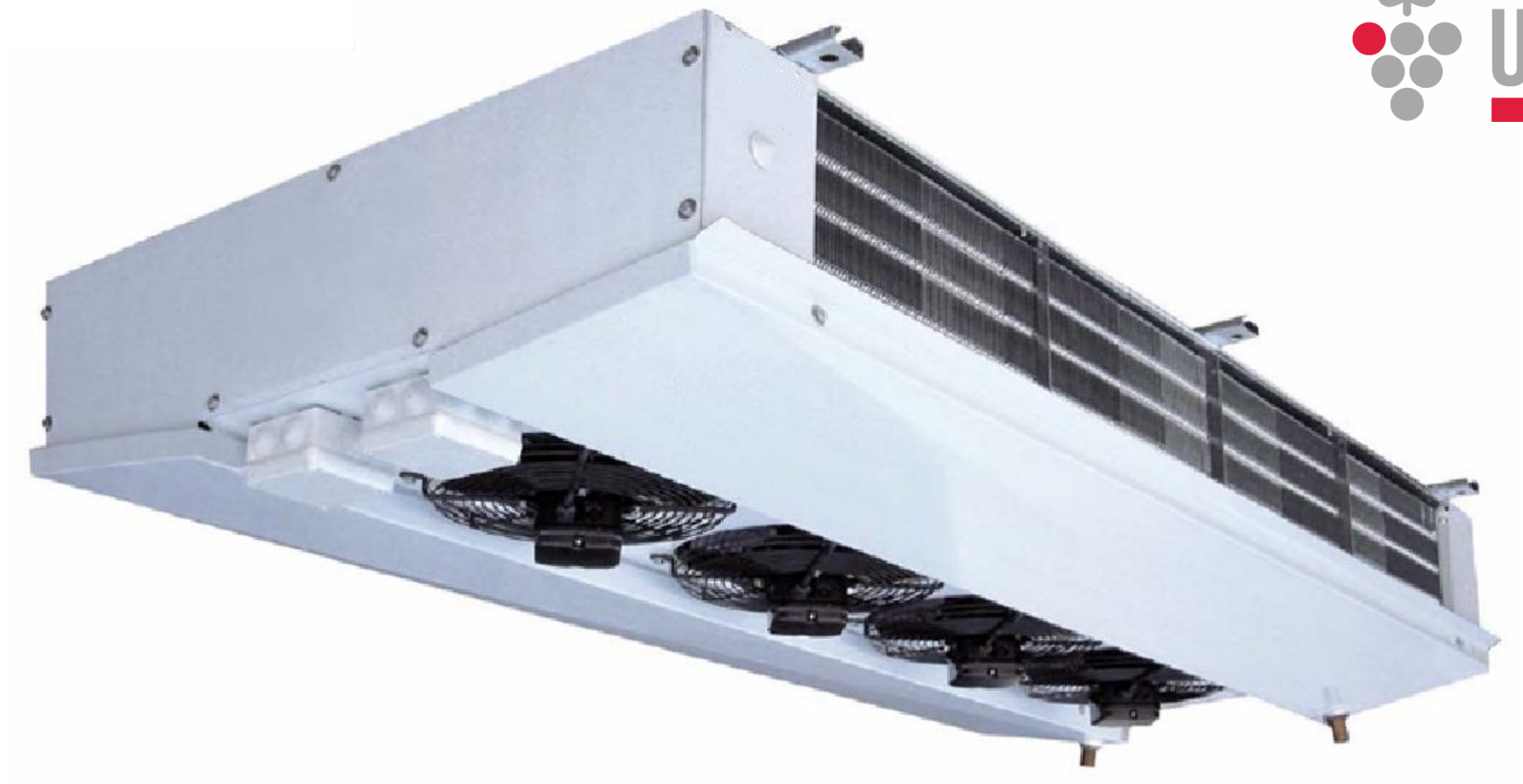
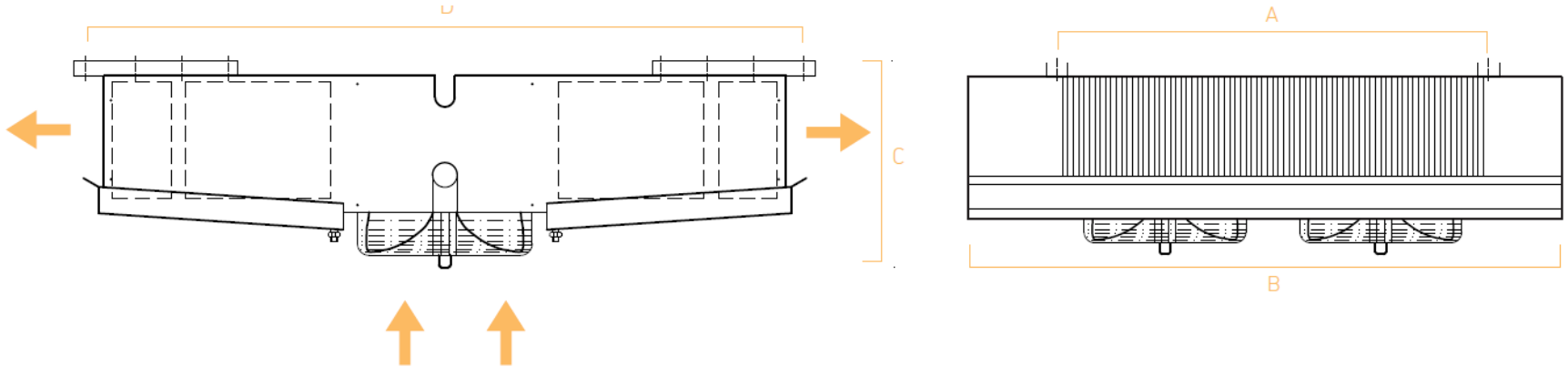
Too low roof and not well-ventilated sorting and trimming / cleaning packing house area

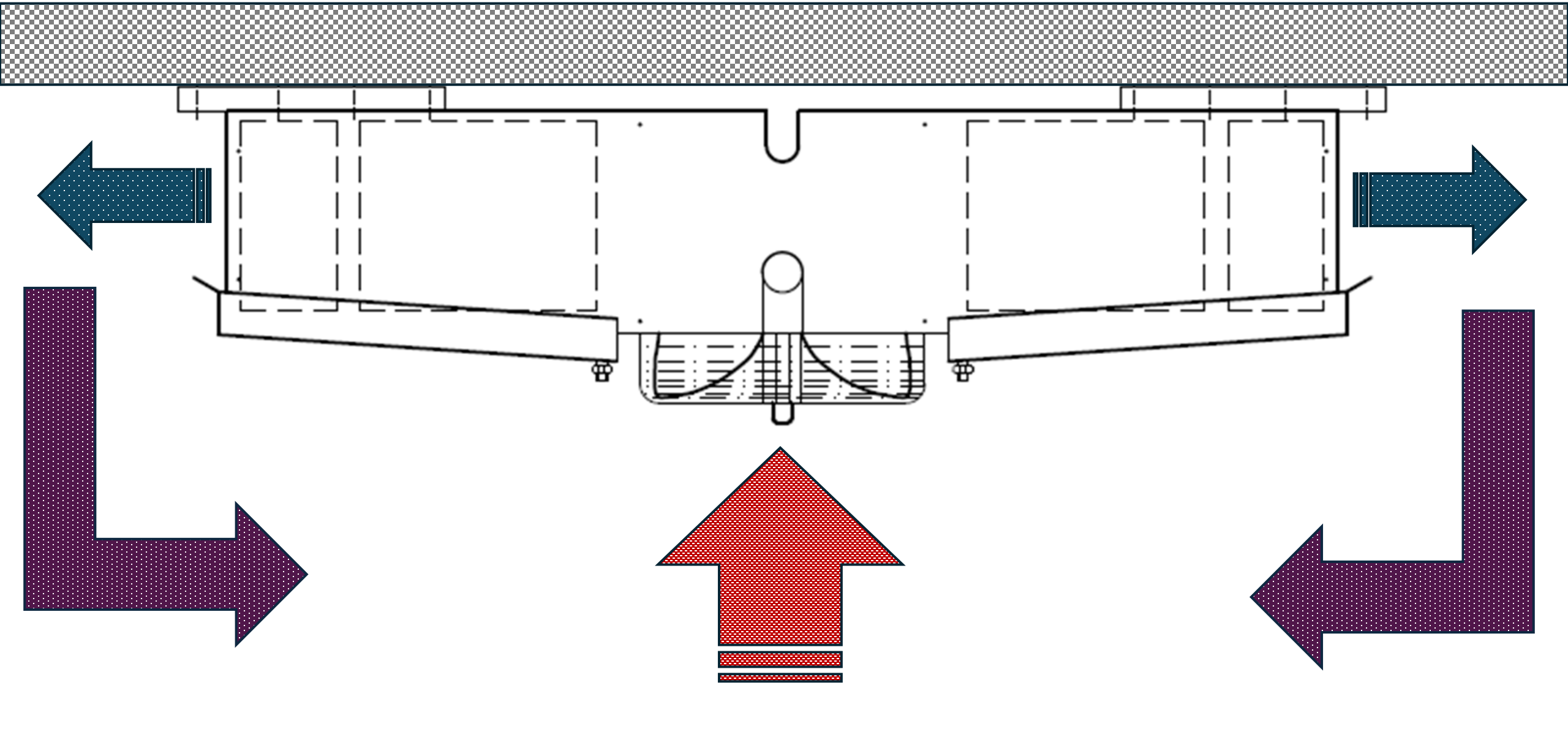




UVASYS









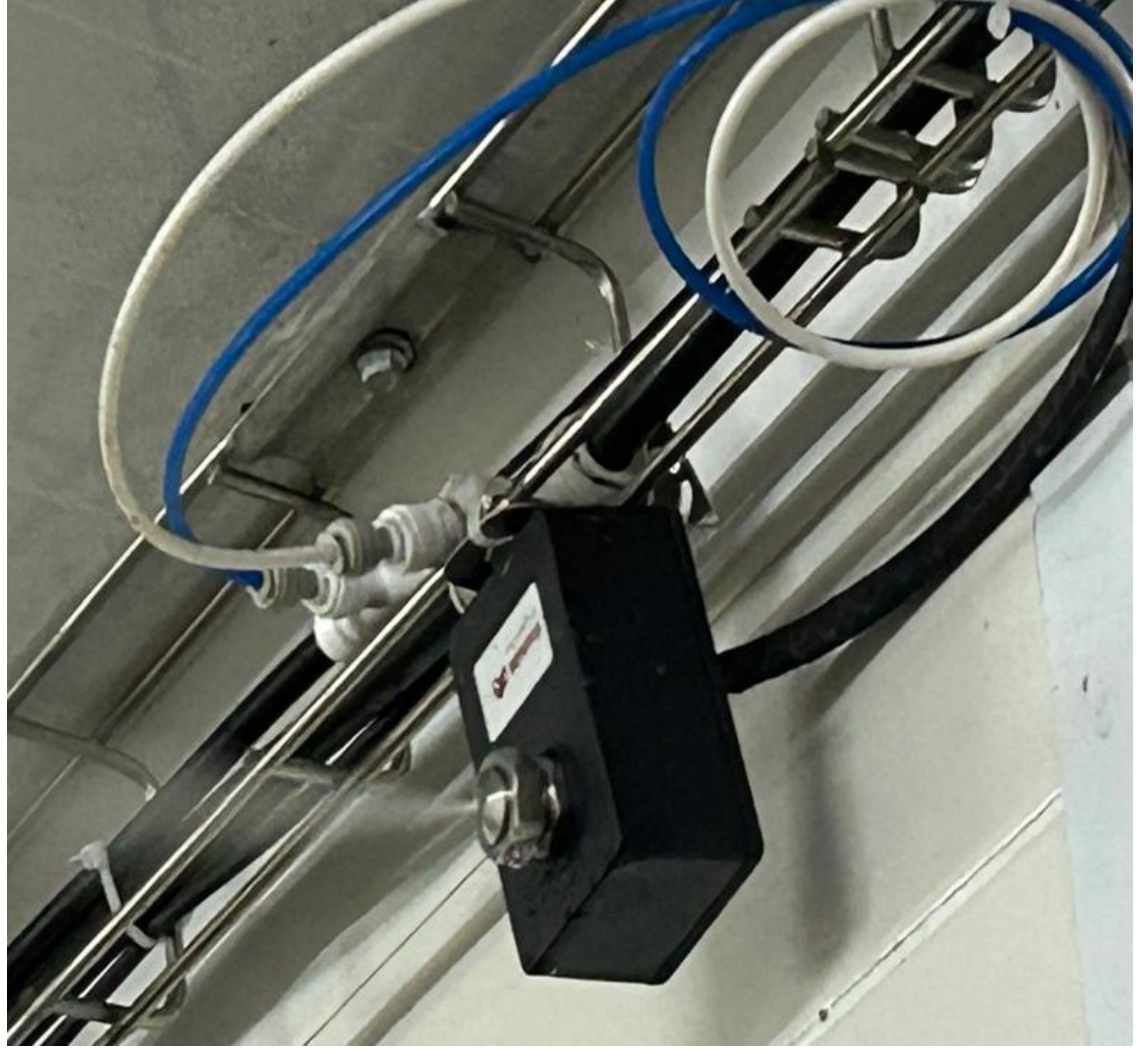




Table grapes received in lugs as raw material are pre-cooled prior to packaging under high relative humidity conditions (90–98% RH), with a target pulp temperature of 17–22 °C. The objective is to maintain the pulp temperature within this range throughout the packaging process. The relative humidity in the packaging area is controlled primarily for personnel comfort. After is palletised, the product enters in a full load into the forced-air pre-cooling tunnel. Condensation conditions must be avoided, and the air dew point temperature should not be reached.

Source: pics O. Salgado, Egypt 2026



Rachis or Stems

- It is a **photosynthetically active**, herbaceous, and turgid green tissue, lacking trichomes and epicuticular waxes.
- **High surface-to-volume ratio.**
- It accounts for **3 to 8% of the bunch weight**, and at harvest may contain between **75 to 80% wate**r; the remainder consists of cellulose, lignin, tannins, and polyphenolic compounds.
- It features functional and **active stomata**, whose density is determined by the variety.
- **The respiratory rate of the stem/rachis is 15 times higher at 20°C than at 0°C. Depending on the variety, stalk /stem quality, and degree of maturity (senescence), respiration can be 10 to 50 times greater than that of the berry.**
- Berries are not sensitive to ethylene, but the stem **is highly sensitive to exposure to this plant growth regulator (PGR).**

(Source: B. Defilippi Bruzzone, Agronomist, Ph.D., Postharvest Unit Coordinator – bdefilip@inia.cl)



Sweet Globe Hex River, South Africa: a 4 semanas de cosecha Enero 2022



UVASYS

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What is Dehydration?

Normal physical phenomenon in plant tissue associated with biochemical activities such as photosynthesis and respiration.
During these processes, plant tissue loses turgor primarily through transpiration via stomata, lenticels, and the epidermis or skin. Water loss through respiration (metabolic water loss) is less significant.
The process is progressive and cumulative.
It is unavoidable and it is irreversible.
The rate of this phenomenon depends on the type of tissue and the **Vapor Pressure Deficit (VPD)** between the surrounding environment and the tissue.
he process can be slowed down but not completely stopped.

What is Browning?

Enzymatic browning, also known as oxidation, commonly affects fruits and vegetables and is closely associated with tissue senescence and over-ripening.
It involves changes in flavour, colour, and overall quality of the produce, which naturally occur over time.
This phenomenon is linked to tissue aging and varies depending on the economic value (appearance and eating quality), whether the tissue is herbaceous, and its respiration rate. In fruit, it also depends on whether it is climacteric or non-climacteric (e.g., table grape berries and stems are non-climacteric).
Browning is the result of a chemical reaction involving enzymes such as **Polyphenol Oxidases (PPO)** and others, which oxidize natural phenolic compounds, producing brown pigments.

Both dehydration and oxidation are interrelated physiological processes that cannot be completely separated, as they are influenced by agronomic management throughout the different stages of cultivation—particularly during the pre-harvest and post-harvest periods.
However, while their symptoms can be observed and addressed individually, from a commercial standpoint, they represent a single, unified issue.

Dehydration process

Transpiration (g/s) = A (Tissue surface area, m^2) x VPD (difference in Vapor concentration between the outside and inside of the Tissue, g/m^3) x P (Surface permeability to transpiration, ease of transpiration, m/s)

Stage 1

Water vapor movement
From higher vapor pressure (VP) to lower vapor pressure (VP)

Tissue Damage

- Water content Initial.
- Maturity
- Sun exposure.
- Freezing



Stage 2

Expression of damage = oxidation, enzymatic process, and antioxidants; tissue type

Brown color development

- Pigments.
- Oxidation / Antioxidants
- Metabolism
- (Ethylene Production)

Source: J.P. Zoffolii 2025





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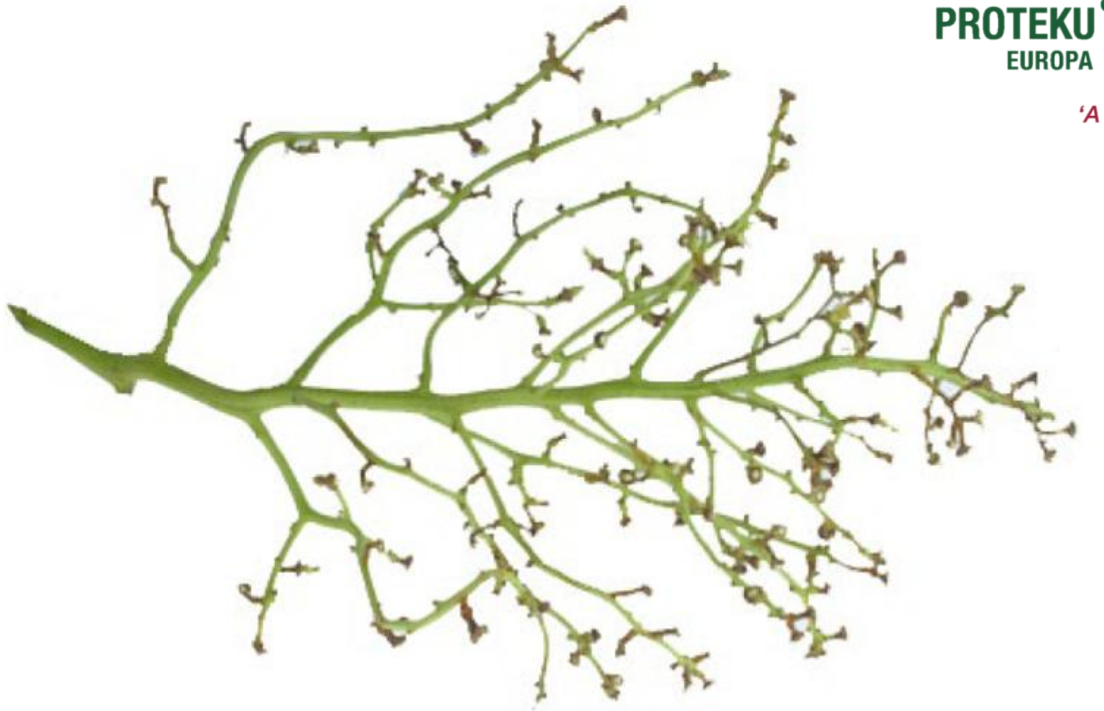
'A grape idea"



Water content: STEM Thickness /Maturity Harvest time

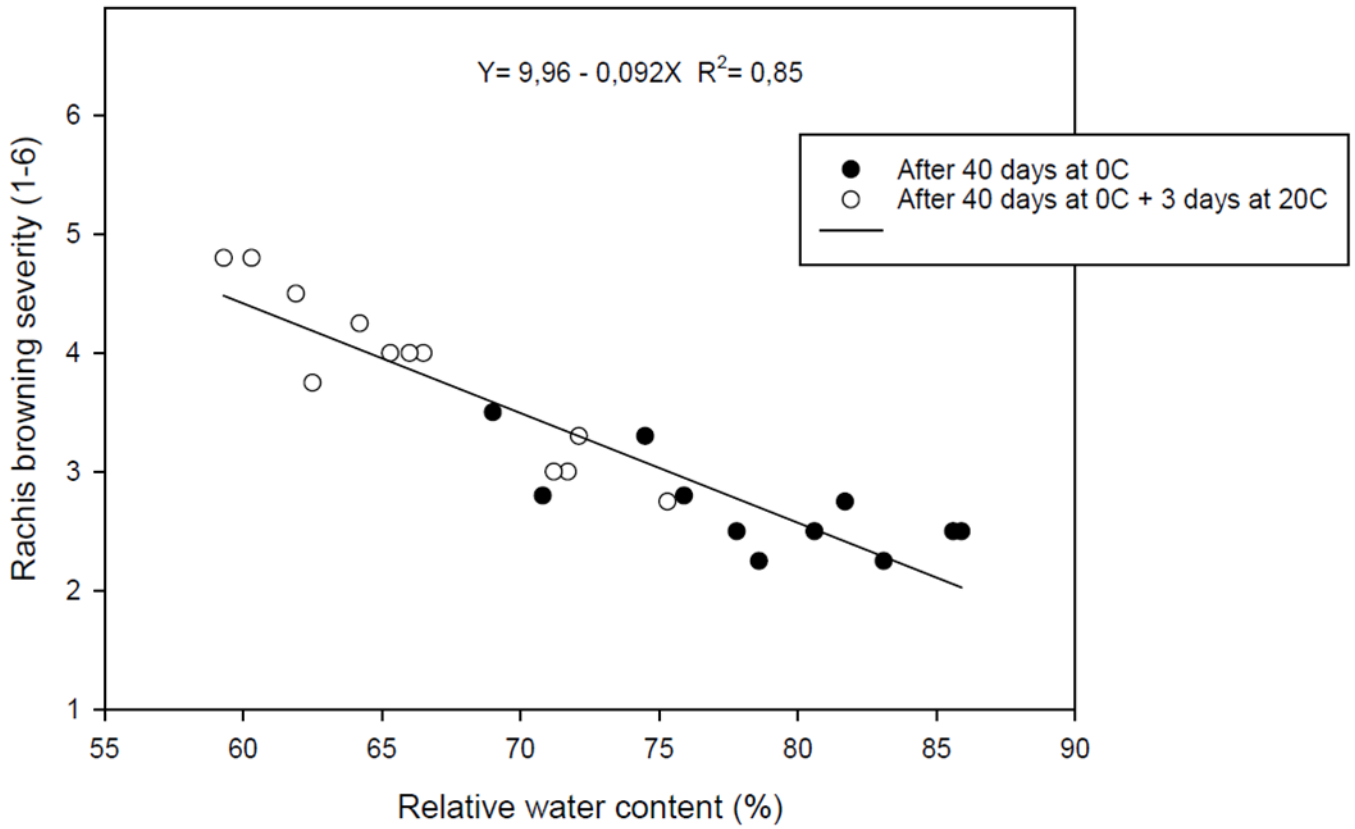
Anti oxidant activity

Metabolic activity

Source: J.P. Zoffolii 2025, AgroFresh Xperience 2025.

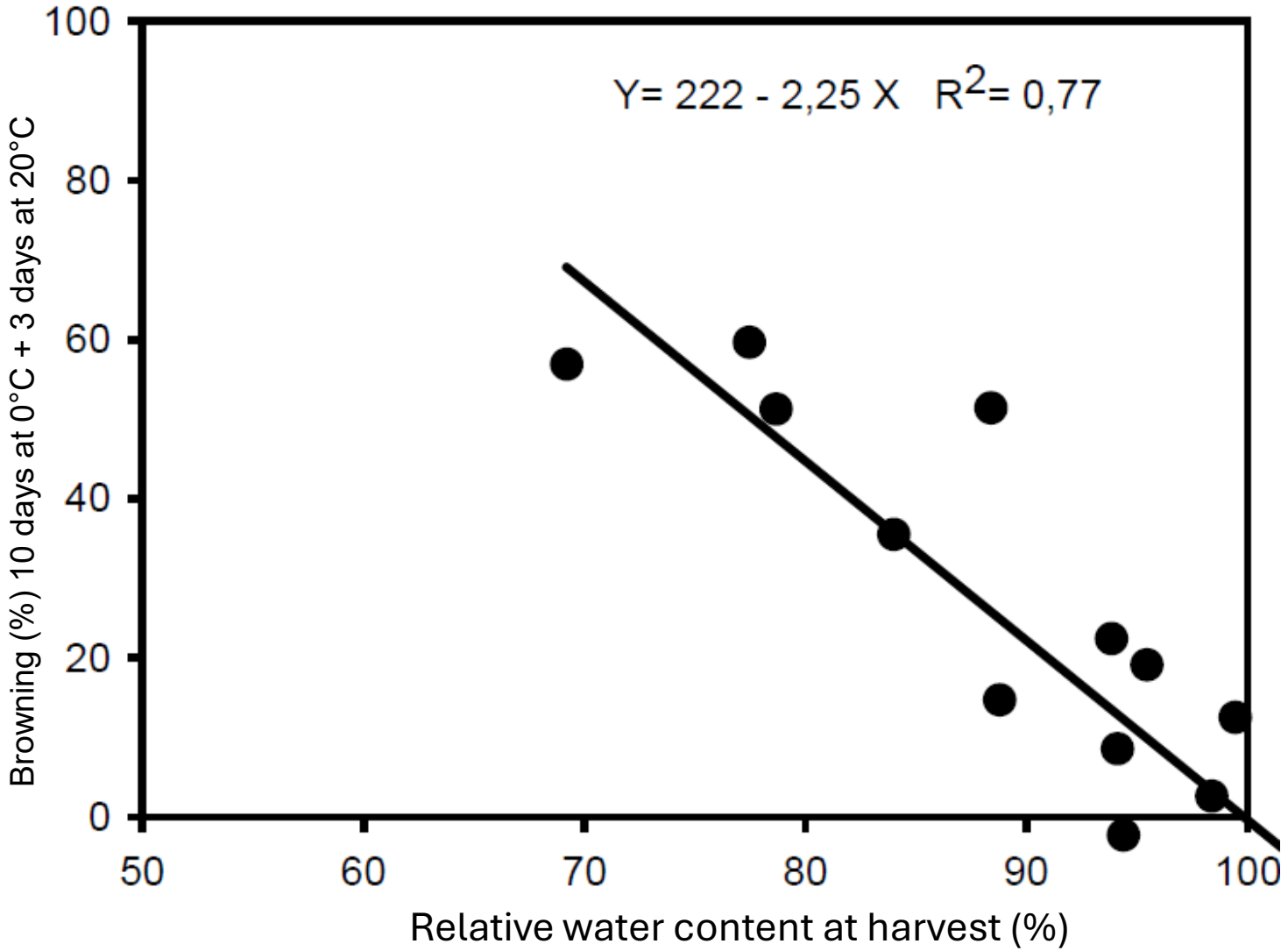
Relationship between relative water content and rachis dehydration in table grapes

Red Globe



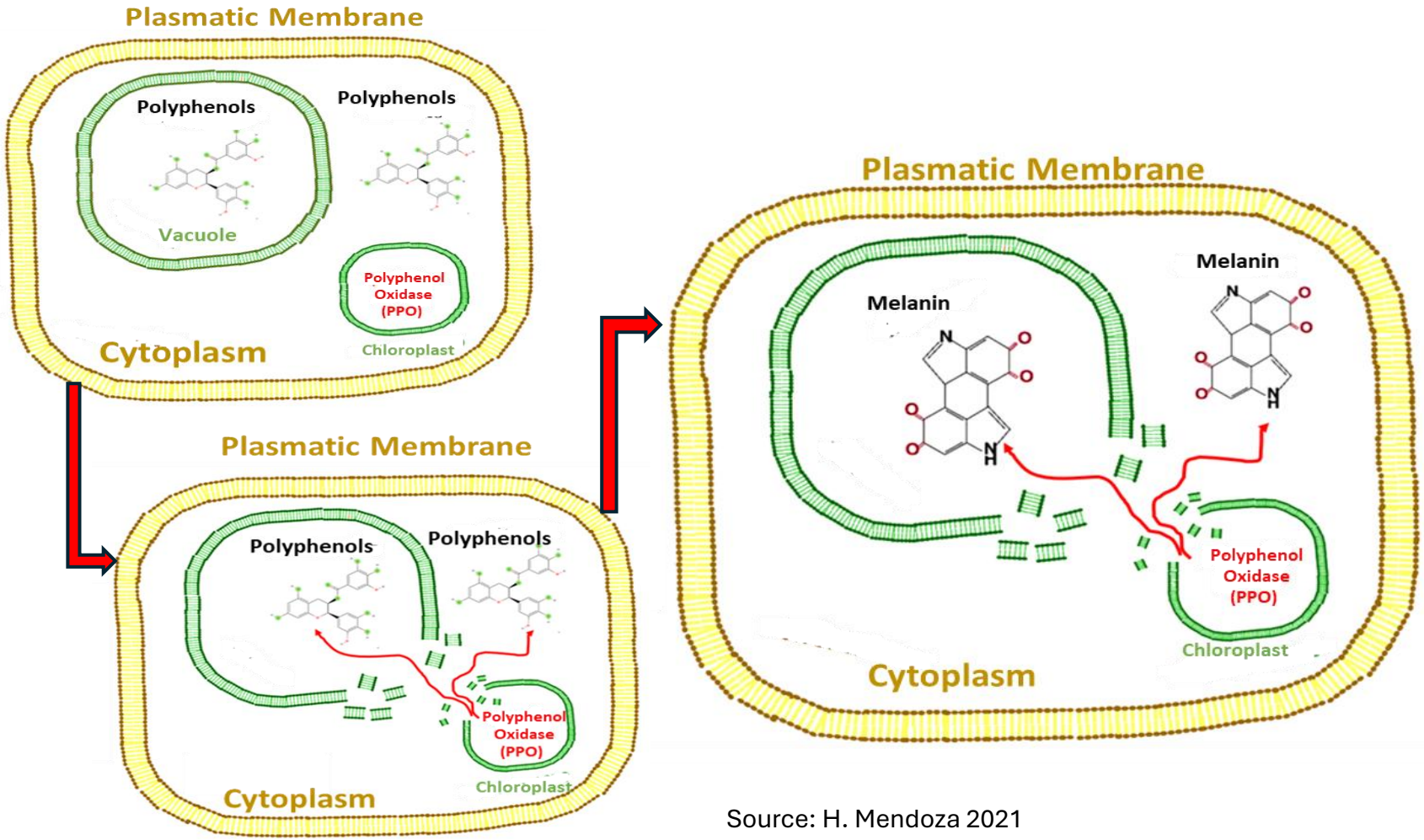
Source: J.P. Zoffolii 2025, AgroFresh Xperience 2025.

Variables that Explain Postharvest Rachis Browning / Relative Water Content at Harvest



Source: J.P. Zoffoli 2025

Stem Browning



Source: H. Mendoza 2021

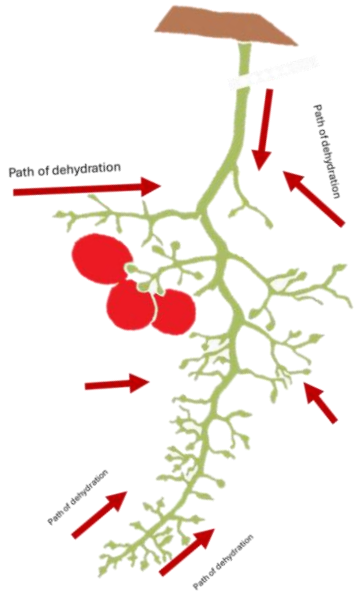
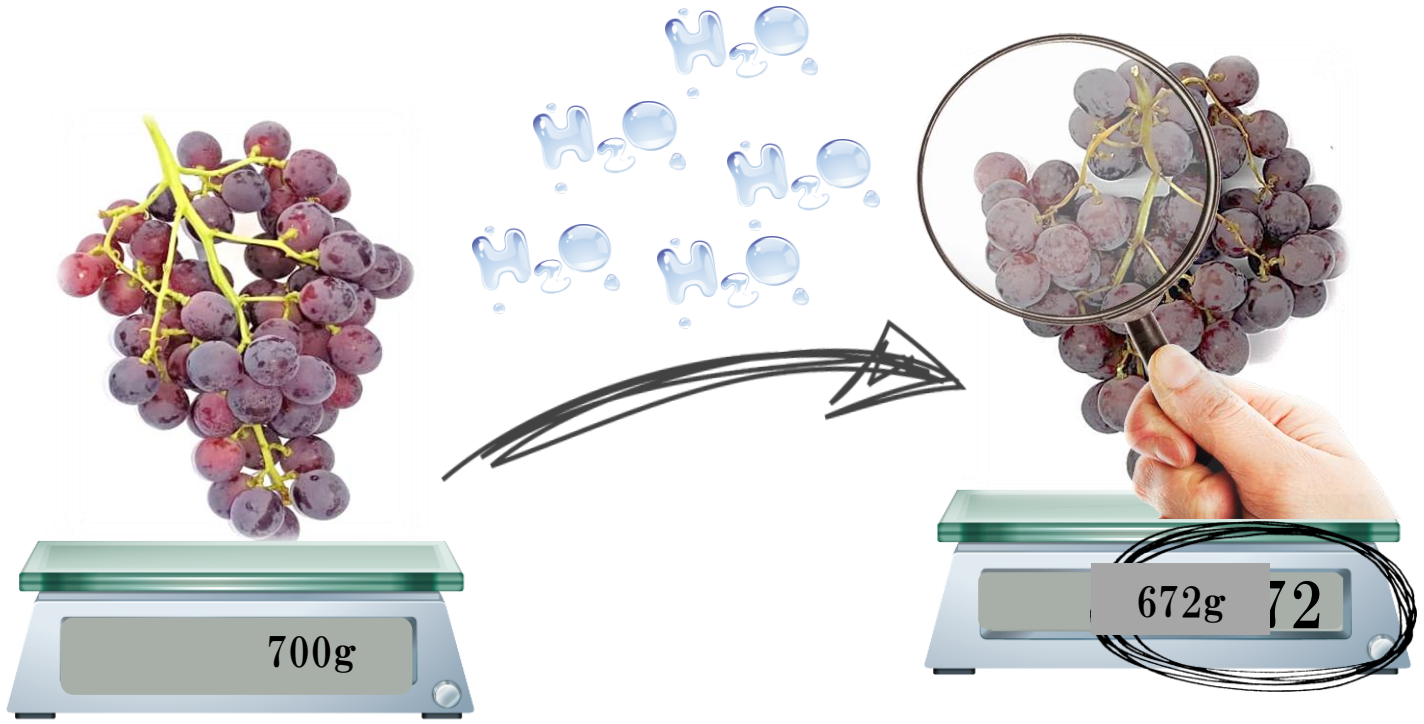


Table Grape dehydration potential



What is Dehydration Potential?

Dehydration Potential

Percentage of water loss from the bunch at which visible signs of dehydration (e.g., browning) appear, leading to commercial impact.

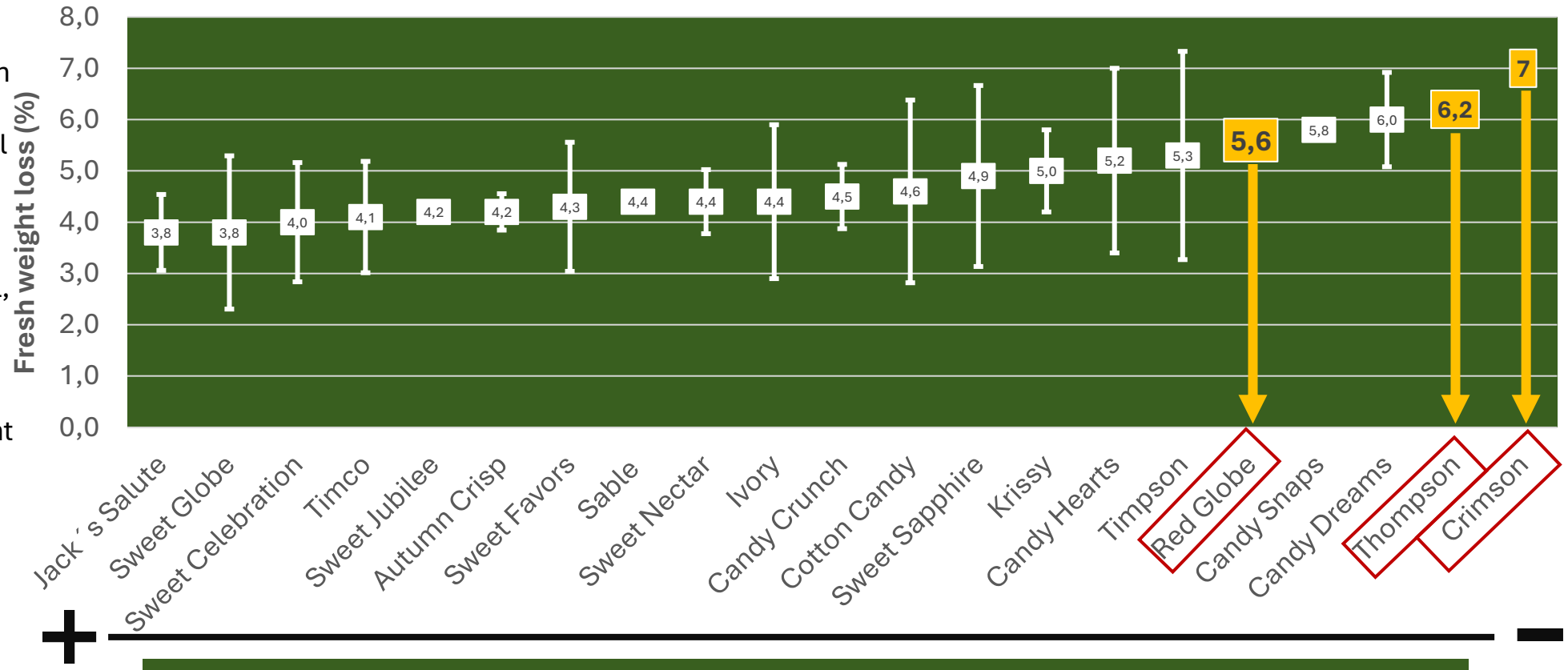
A higher dehydration potential indicates that more weight must be lost before symptoms become visible. This reflects greater resistance to dehydration.

Source: Adapted from O . Salgado from Rio King December 2023, large Chilean exporters, summary from the USA Market, Infruta and Proteku Webinar December 2023, “Dehydration in table Grap

Potential dehydration results per variety

- Dehydration potential by variety

The lower the dehydration potential, the more symptoms of commercial impact the rachis browning / desiccation will have, and the higher the dehydration potential, the less intense the damage will be. Thus, to show damage in Jack Salute, only a 3.8% weight loss is commercially important, and in Crimson we need to lose 7% to see the same intensity, under this trial.
O. Salgado



Source: Rio King December 2023, large Chilean exporters, summary from the USA Market, Infruta and Proteku Webinar December 2023, “Dehydration in table Grape”

Dehydration (weight loss) according to the steps of process

Harvest till pack shed
Weight loss

Traditional Chilean packing 0,3% /hour
5 in hours: 1,5%

Packing till fast force precooling tunnels
Weight loss

Traditional packing: 0,09% /hour
5 in hours: 0,45%

Fast force precooling tunnels
Weight loss

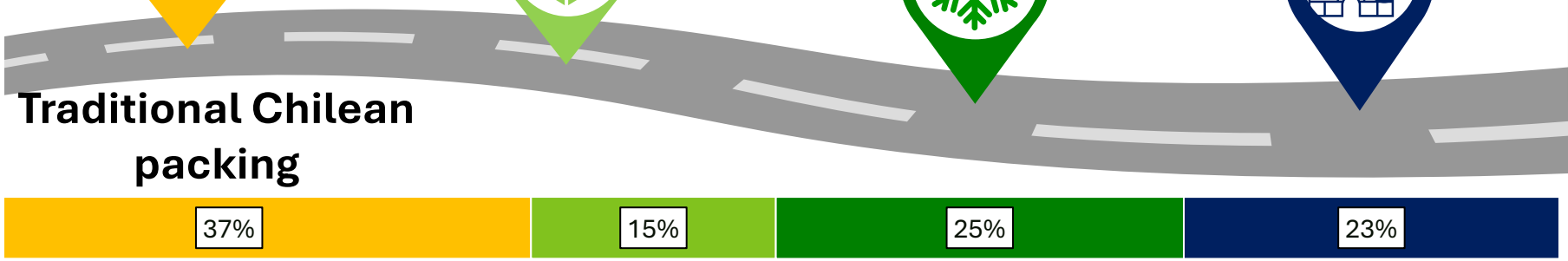
0,075%/hour
13 hours: 0,98%
24 hours: 1,8%
36 hours: 2,7%
48 hours: 3,6%

Holding cold rooms Cold storage
Weight loss

0,03%/day
30 days: 0,90%

TOTAL
Weight loss
Traditional Chilean packing: 3,83%

100% Water loss



Source: Rio King December 2023, large Chilean exporters, summary from the USA Market, Infruta and Proteku Webinar December 2023, “Dehydration in table Grap

Chile: weight lose during Forced single Precooling tunnel: 0,075%/hour of cooling

In 13 hours: 0,98%

In 24 hours: 1,8%

In 36 hours: 2,7%

In 48 hours: 3,6%

Weight Loss and Visible Damage to the Rachis

Critical Initial Weight Loss: Visible rachis dehydration (loss of turgor, browning, and tissue collapse) generally begins when bunches lose 2–3% of their total fresh weight.

Moderate Damage: Starting at 3–5% weight loss, the rachis shows evident browning, loss of luster, and a dry texture, especially in bunches located at the top of the boxes or exposed to greater ventilation.

Severe Damage: With losses exceeding 5–6%, necrosis, collapse of the main rachis, and lateral branching appear, affecting the bunch's commercial appearance and perceived freshness.



Source:

Table grapes suffer water loss, stem browning during cooling delays (Carlos H. Crisosto, Joe L. Smilanick & Nick K. Dokoozlian; California Agriculture 2001)

Water loss in table grapes: model development and validation under dynamic storage conditions (Pereira et al., Food Science & Technology 2014 aprox)

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'A grape idea"

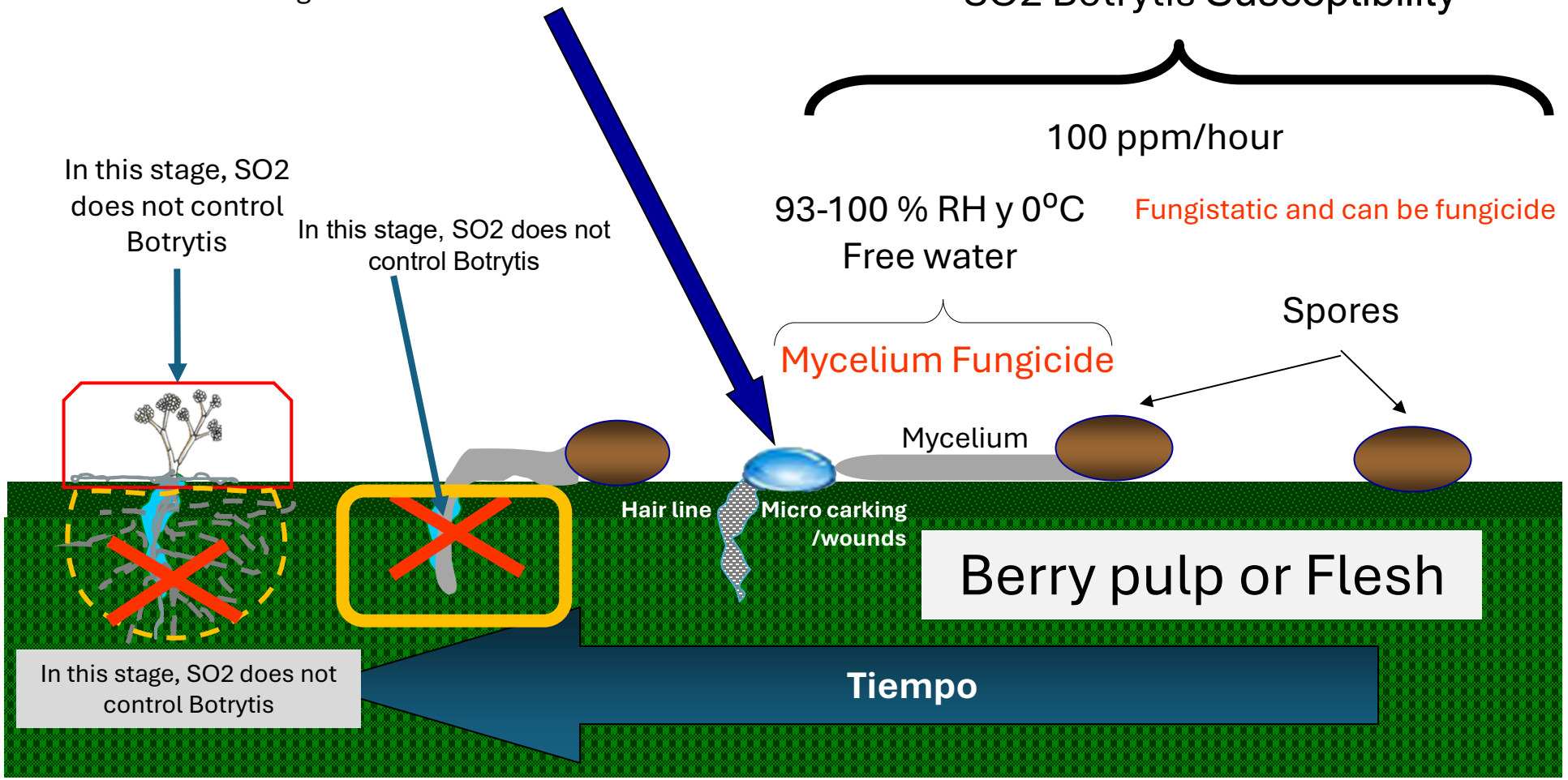

We're not going to argue anymore.....

How Does SO_2 Control Botrytis? Sodium Metabisulfite

Na2S2O5 + H2O------2NaHSO32 NaH
SO3 + ½ O2------ SO2 + Na2SO4+H2O

Botrytis cinerea Pers., the causal agent of Gray Mold, causes significant losses in table grapes (Vitis vinifera L.), both in the preharvest and postharvest stages. In general, it is accepted that flowering and the period between veraison (when soluble solids [SS] reach approximately 8–10%) and harvest are the most vulnerable phenological stages of the vine. Consequently, these are the critical periods during which fungicide applications are required.

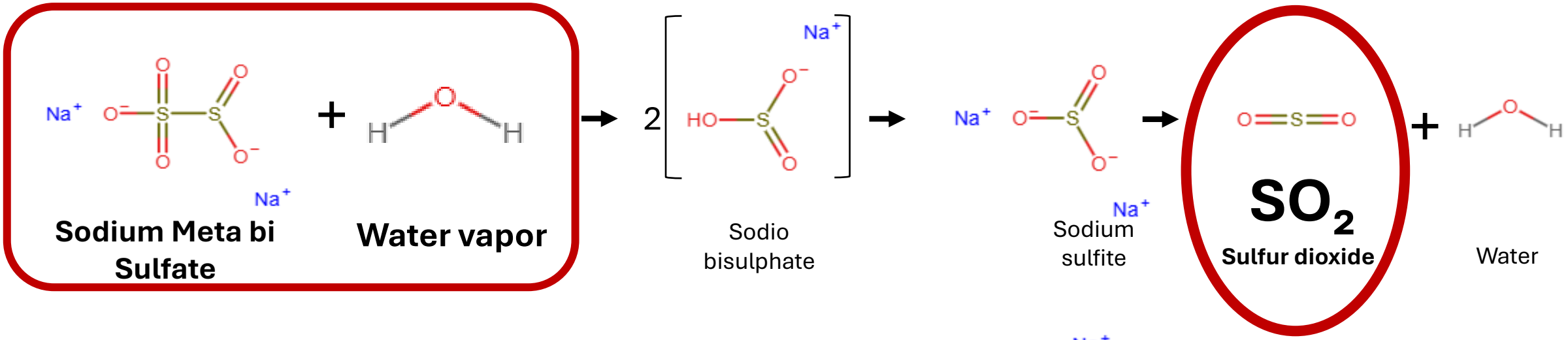
Moisture/free water, Carbohydrates (Sugars), and Structural Disruptions (Microcracks and Wounds) as Predisposing Factors for Postharvest Pathogen Infections



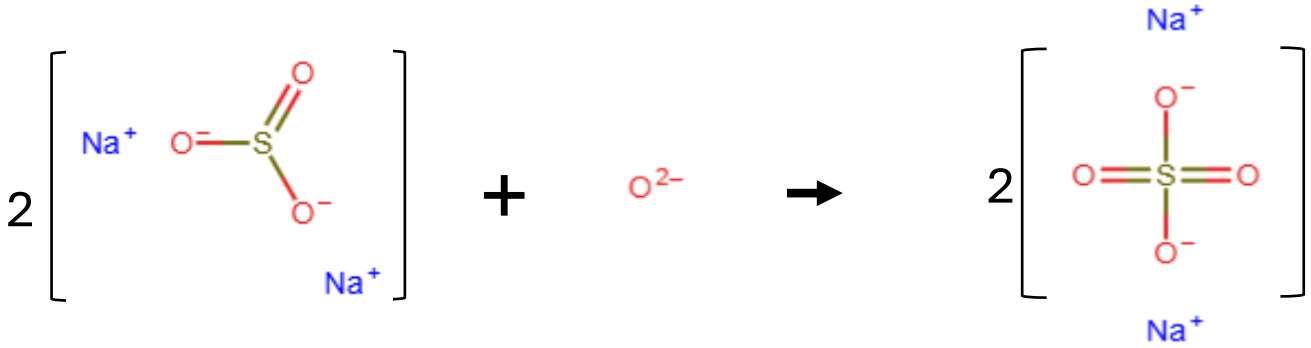
Fuente: O. Salgado 2006

SO2 Pads Chemical reaction of the Salt of Sodium Meta bi sulphate (SMBS)

(1)

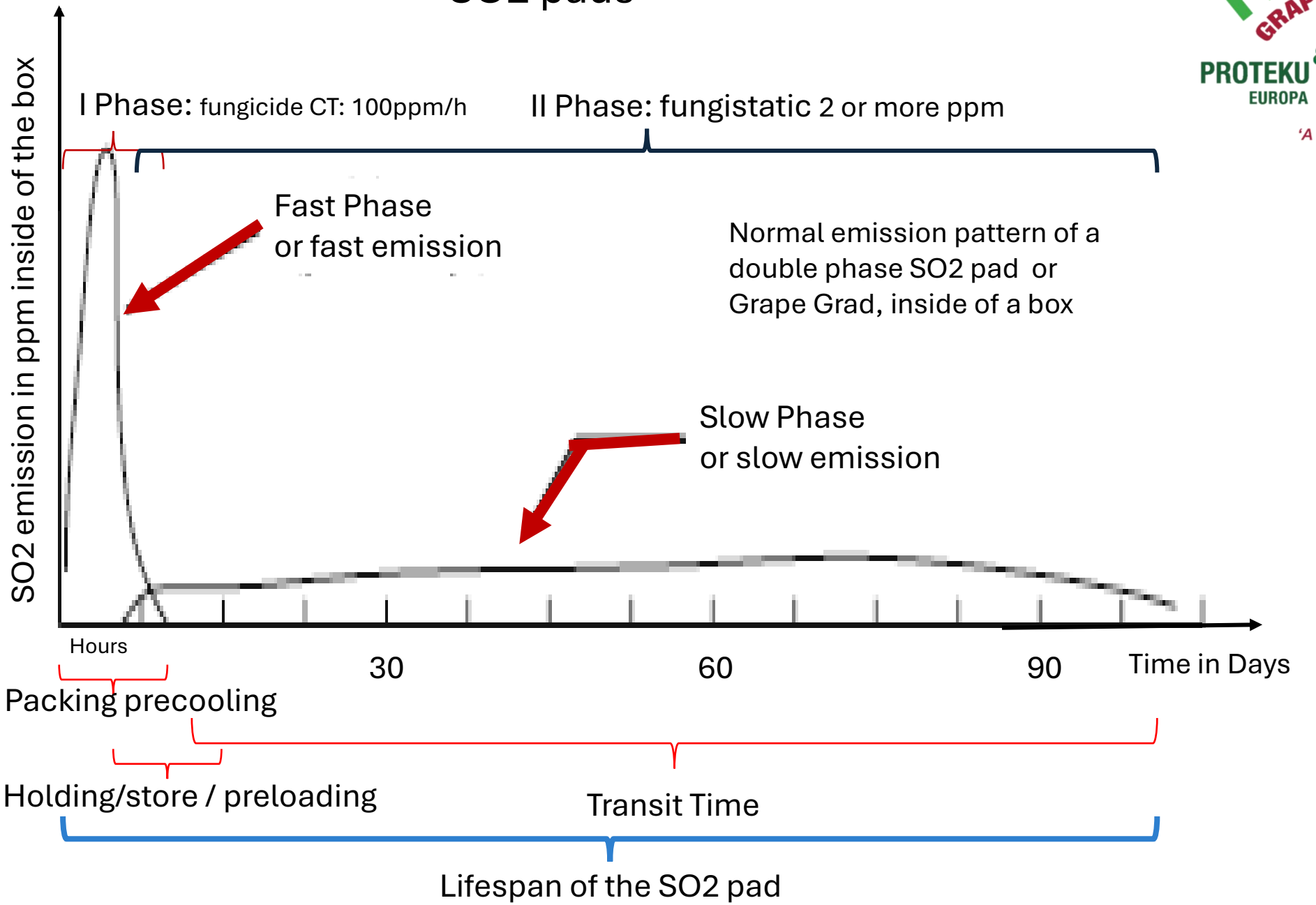


(2)



Source: D. Silvia 2025

SO2 pads


I Phase: fungicide CT: 100ppm/h
II Phase: fungistatic 2 or more ppm
Fast Phase
or fast emission
Normal emission pattern of a
double phase SO2 pad or
Grape Grad, inside of a box
Slow Phase
or slow emission
SO2 emission in ppm inside of the box
Hours
30
60
90
Time in Days
Packing precooling
Holding/store / preloading
Transit Time
Lifespan of the SO2 pad

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The bad guy or Botrytis Forecast

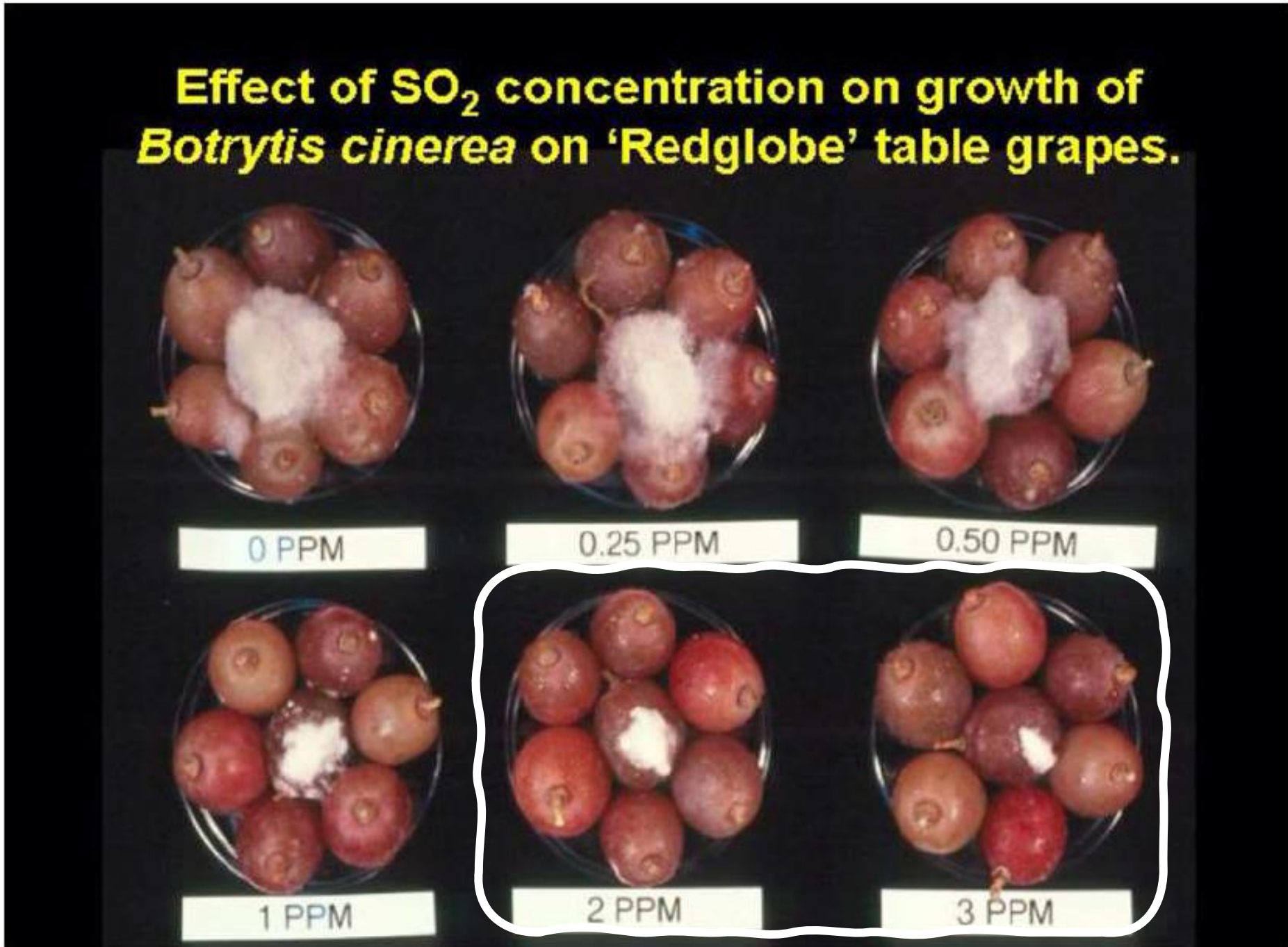
UVASYS



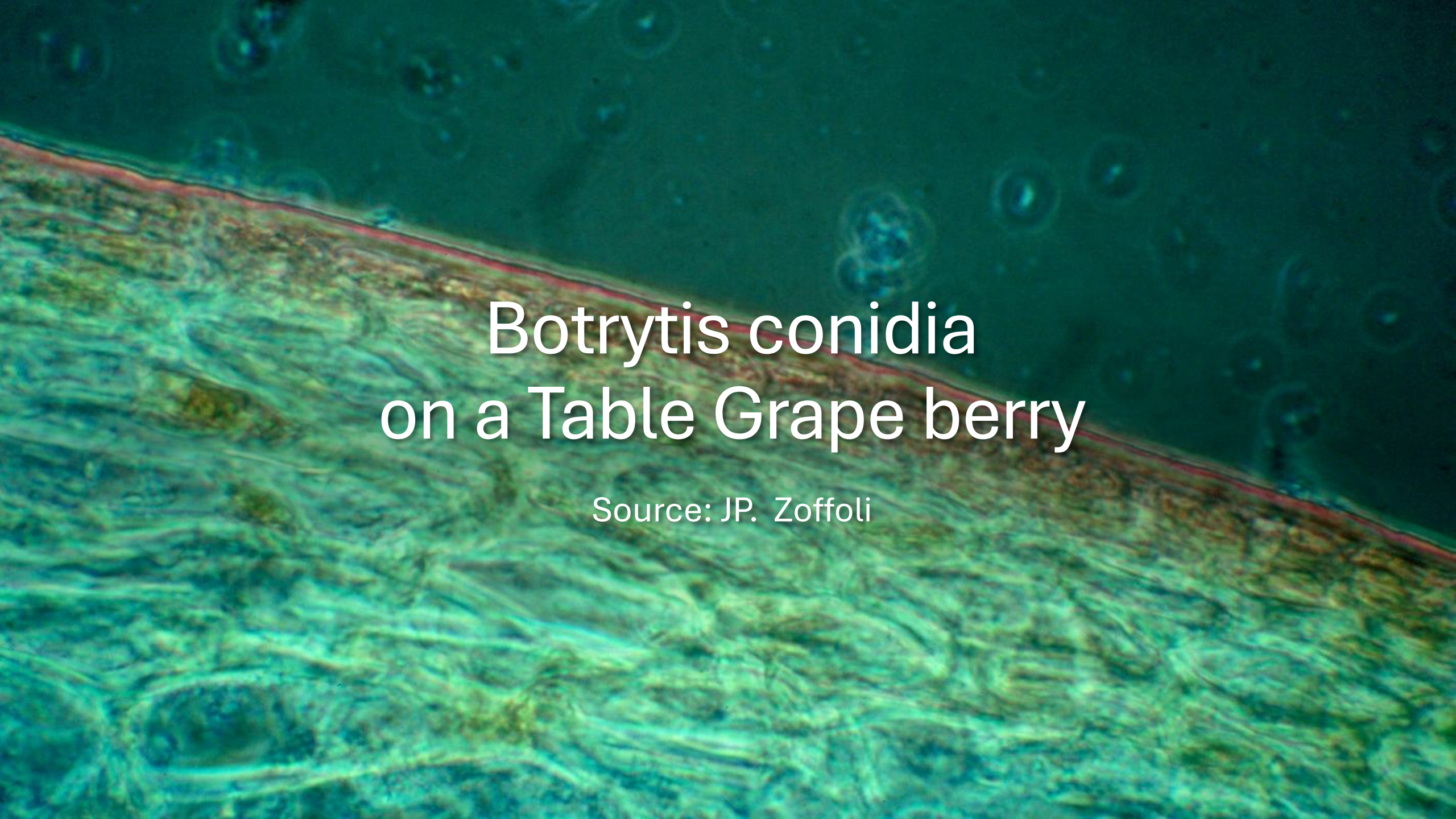




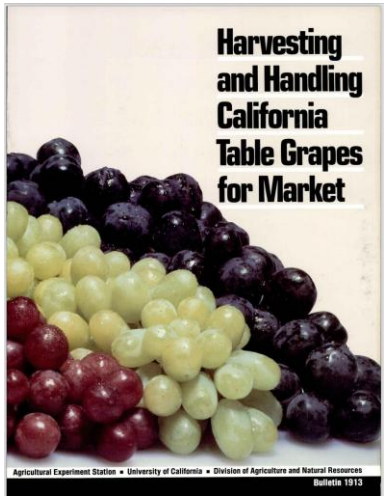
SO2 concentration to control disease progression.



Source: CURSO FISIOLOGÍA Y TECNOLOGÍA DE POSCOSECHA EN UVA DE MESA. Pontificia Universidad Católica de Chile – Facultad de Medicina – Ucvirtual 2023


Botrytis conidia
on a Table Grape berry
Source: JP. Zoffoli





No fruit should be further than 4 inches (10 cm) from a generator surface since the concentration gradient of the SO_2 decreases by about a factor of 50 percent for every inch (2.5 cm) of distance from the generator. If the pack is deeper than 4 inches (10 cm), both top and bottom generators should be used. If the pack is shallower, but wider and longer, both generators may be used side by side on top of the grapes. It is usually in the corners of the pack—at the greatest distance from the generator—that decay is most apt to develop. Page: 50

"Concentration of SO2 decreases by a factor of 50% for every inch (2.5cm) of distance from the sheet"

Source: Klayton Nelson, 1979

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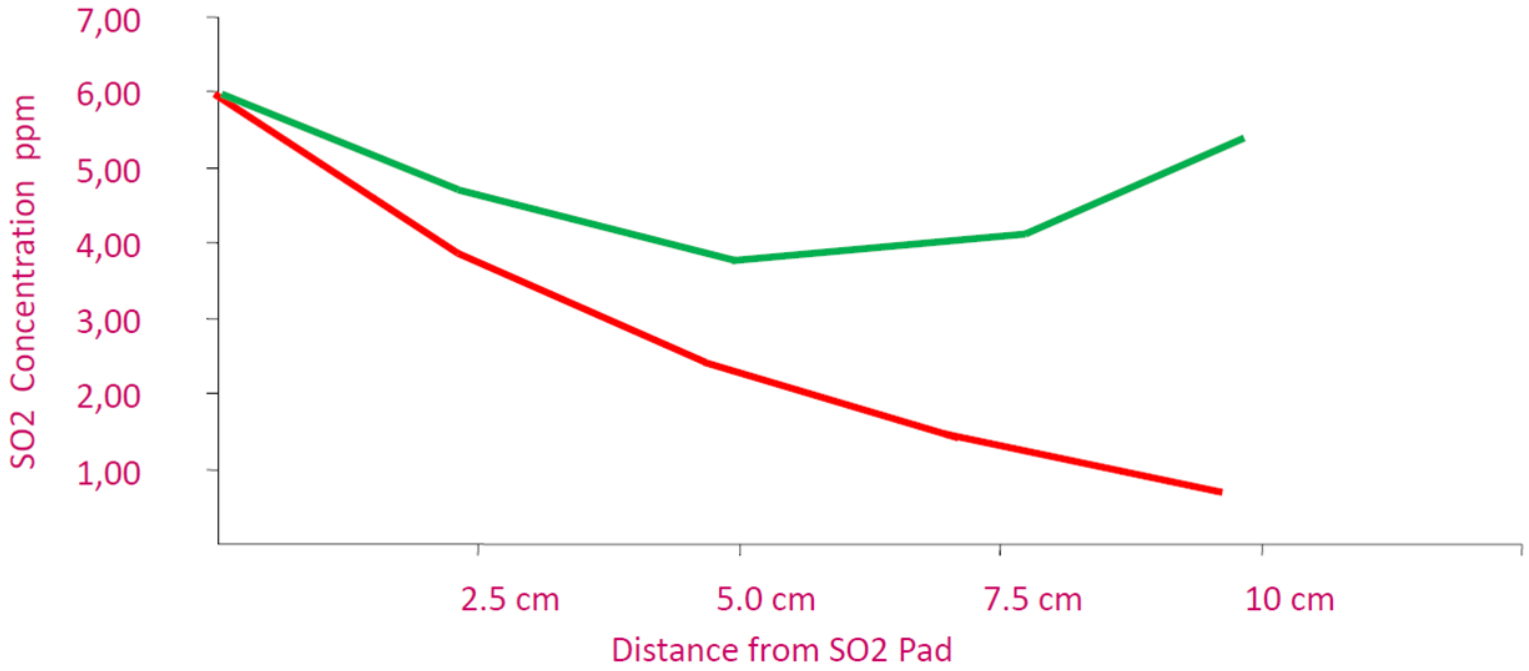
tA grape ideal

SO2 Concentration with TOP and BOTTOM Pad

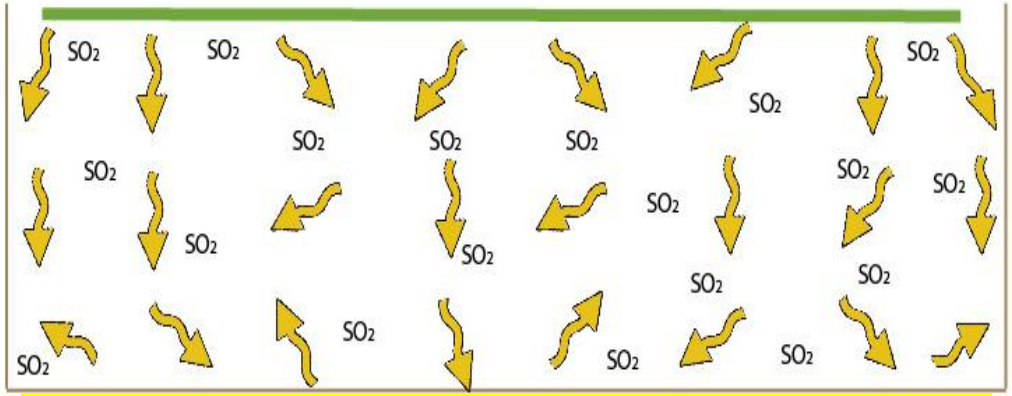


The combination of TOP and BOTTOM pads brings better and more uniform distribution of SO2 across the box.

- The study also confirms that SO2 pads of larger size (better box coverage) also help to improve the SO2 distribution inside the box, particularly by reaching the corners.

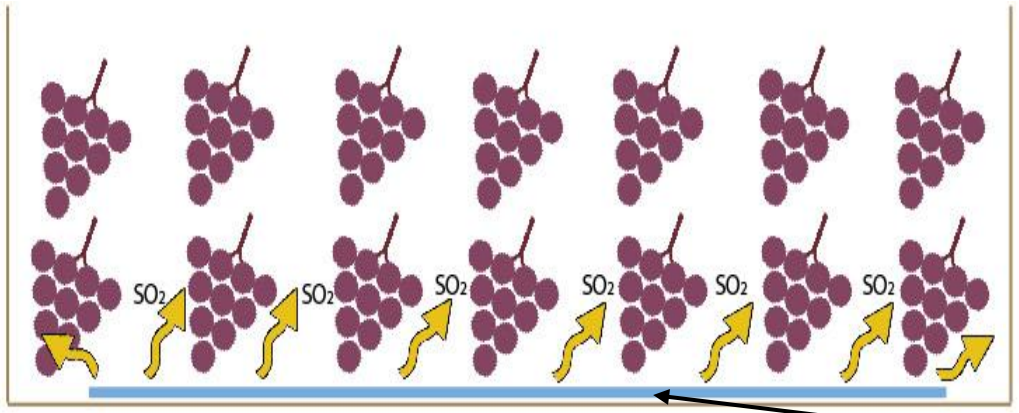
SO_2

SO_2 MOVEMENT IN AN EMPTY BOX, WITHOUT GRAPES, WITH A GENERATOR PAD ON TOP

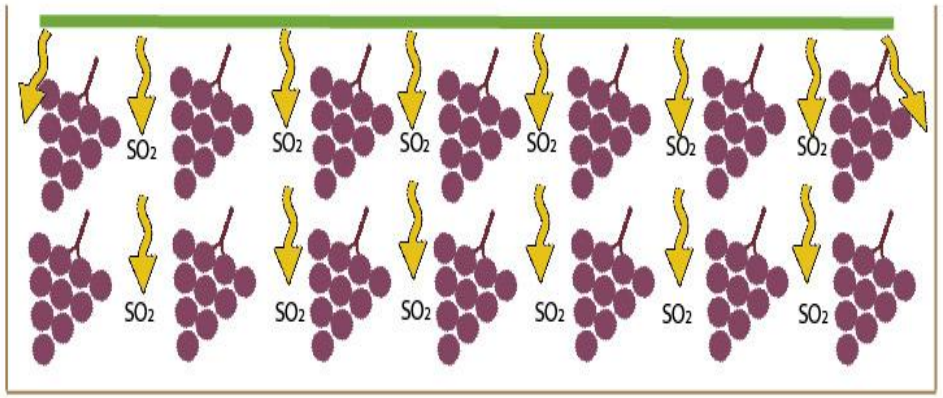


Ideal gas theory: A gas always uses the entire volume that contains it. Approximately, sulphur dioxide (SO_2) is about 2.2 times heavier than air under the same pressure and temperature conditions (e.g., at sea level).

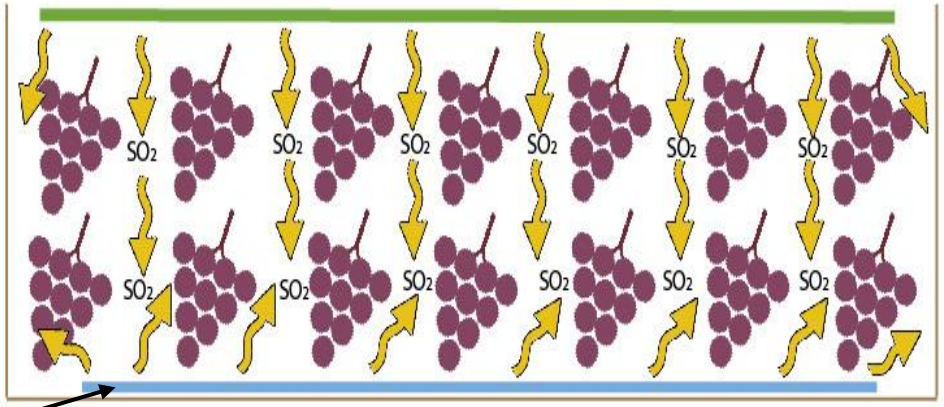
SO_2 MOVEMENT WITH A BOTTOM GENERATOR PAD



SO_2 MOVEMENT WITH A GENERATOR PAD ON TOP, COVERING MORE THAN 75% OF THE INTERNAL AREA OF THE BOX



SO_2 MOVEMENT WITH TOP AND BOTOM GENERATOR PADS, COVERING MORE THAN 75% OF THE INTERNAL AREA OF THE BOX



*** Ideal packaging for periods over 25/30 days**

SO2 Bottom pad

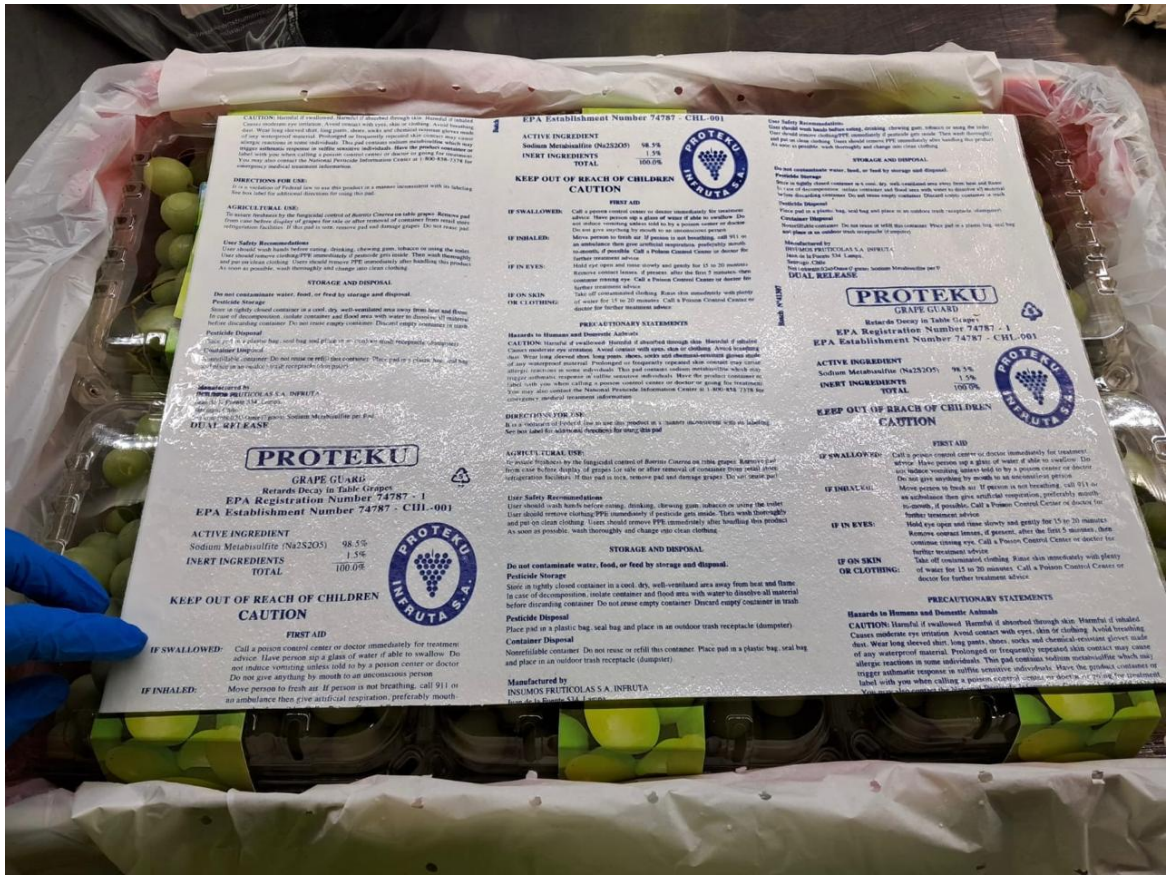
SO_2 Bottom pads

should cover above 70% of the total working surface



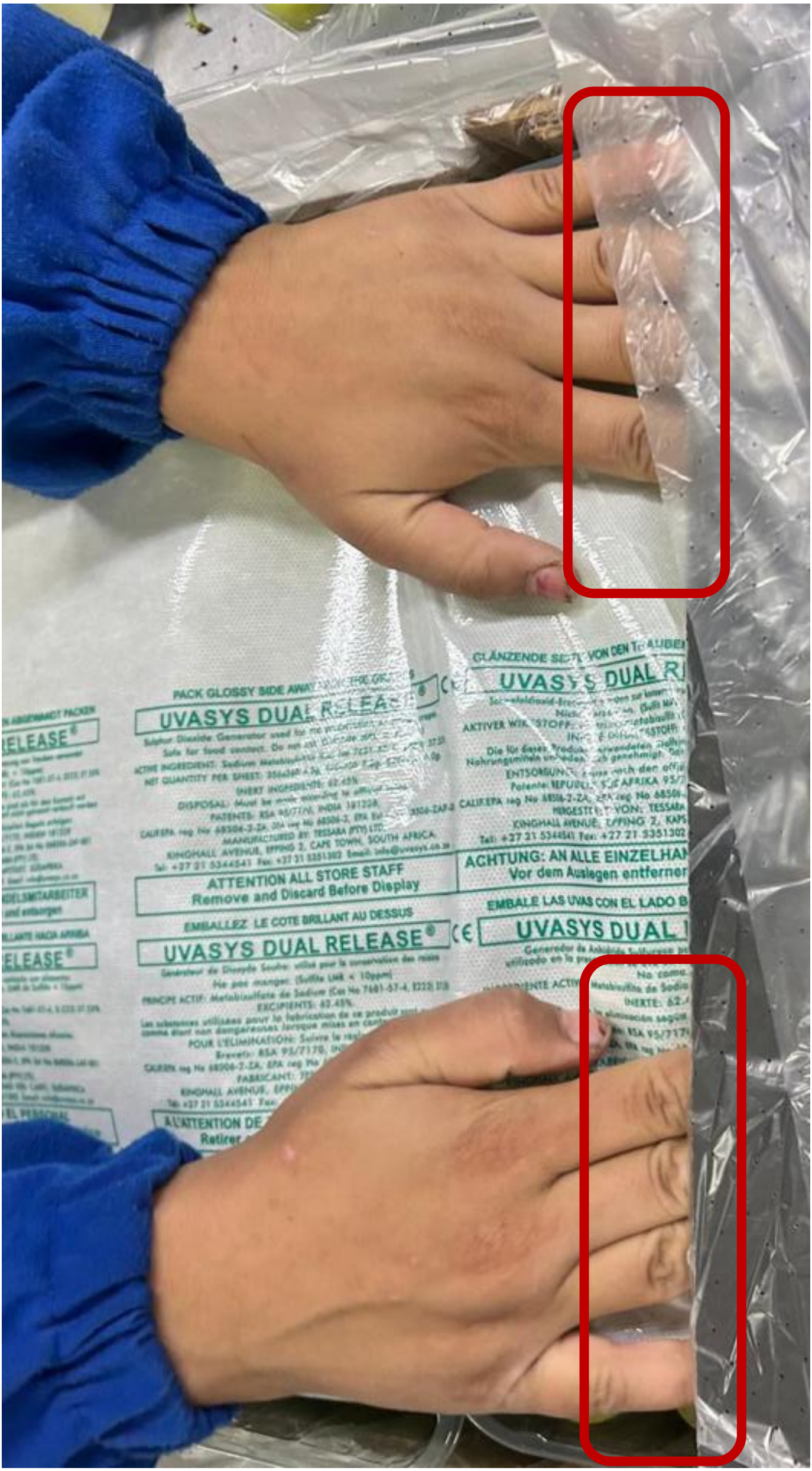


SO_2 Top Pads





Optimal packaging requires covering at least 70% (
I go for 80%) of the box's internal surface area


PACK GLOSSY SIDE AWAY
UVASYS DUAL RELEASE
ATTENTION ALL STORE STAFF
Remove and Discard Before Display
EMBALLEZ LE COTE BRILLANT AU DESSUS
UVASYS DUAL RELEASE
ACHTUNG: AN ALLE EINZELHAN
Vor dem Auslegen entferner
EMBALE LAS UVAS CON EL LADO B
UVASYS DUAL

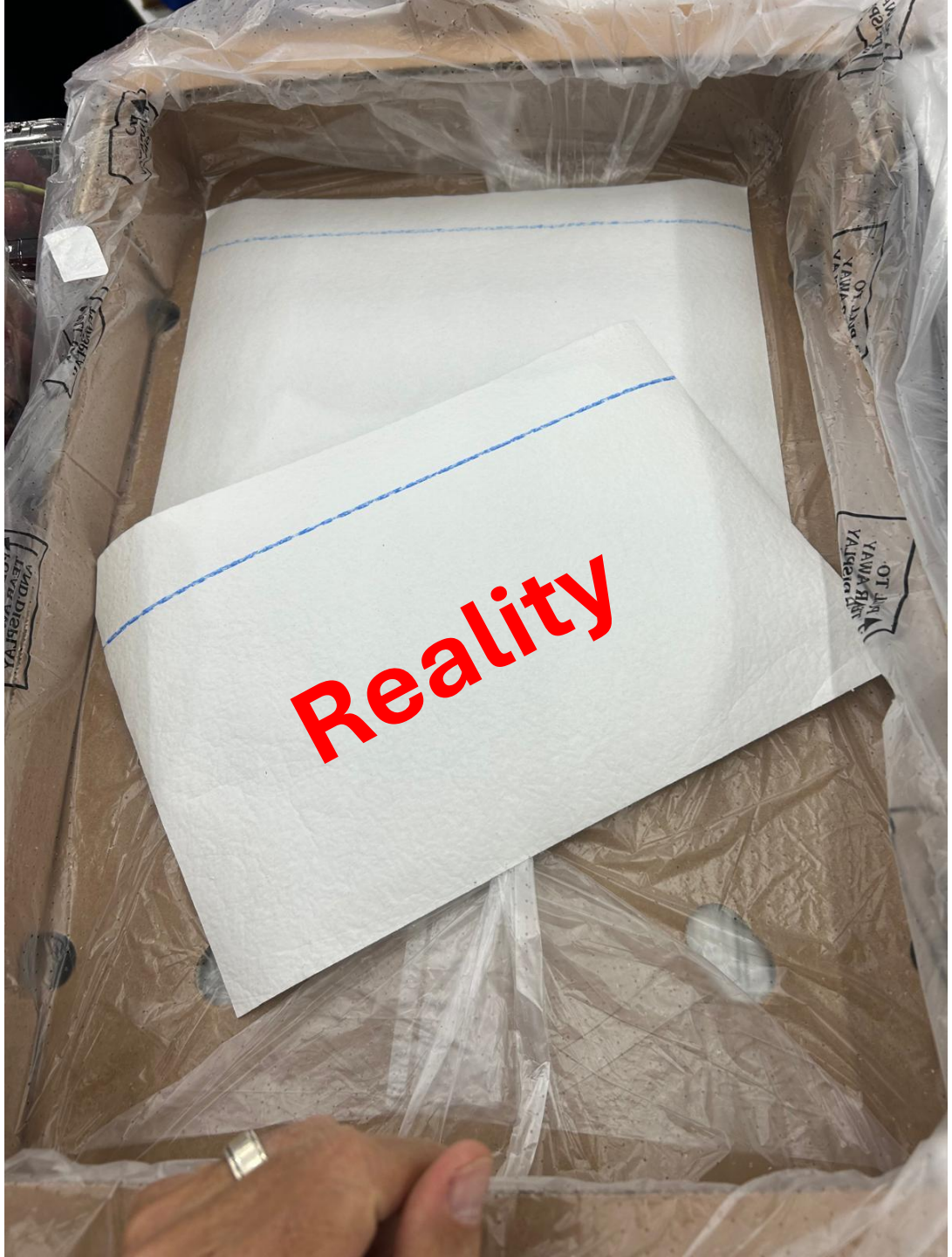
SO_2 Top Pads





Source: D. Silva 2025


Dream


Reality




TAFELTRAUBEN
500 g



Postharvest Studies on SO_2 as an Antioxidant for Table Grape Pedicel Preservation

The following studies in English, Spanish, and Italian identify sulphur dioxide (SO_2) as an effective antioxidant treatment for table grapes, particularly for preserving the pedicel (rachis) during postharvest handling. These studies highlight the role of SO_2 in preventing oxidative degradation, thus maintaining the green and fresh appearance of the pedicel, which is a key quality parameter in table grapes.

English sources:

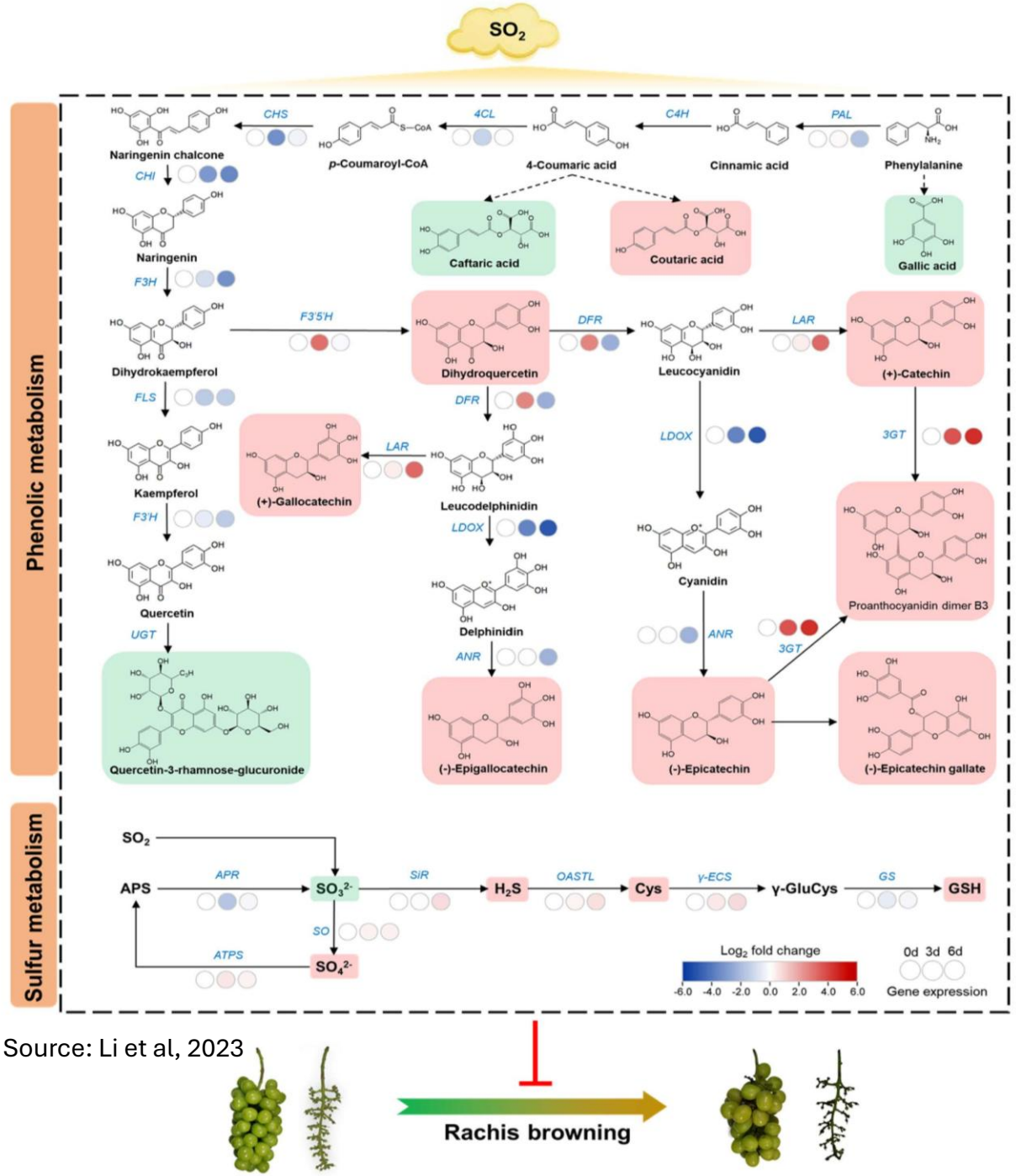
- **Wang, J., Zhang, D., & Li, Z.** (2010). Effect of sulfur dioxide treatment on postharvest quality and storage life of table grapes (Vitis vinifera L.). Postharvest Biology and Technology, 57(1), 12-17.[DOI: 10.1016/j.postharvbio.2010.01.004]
- **Bhat, A., & Kumar, V. (2013**). Antioxidant effects of SO2 treatment on table grapes and its impact on shelf life and microbial activity. Food Chemistry, 136(3), 940-945.[DOI: 10.1016/j.foodchem.2012.08.056]
- **Cantarella, L., & D'Incecco, N. (2016).** Postharvest treatment with sulfur dioxide and its effect on oxidative stress in grapes. Food Research International, 79, 54-61.[DOI: 10.1016/j.foodres.2015.11.006]
- **López-González, F., Rodríguez-Burruezo, A., & Ortega-Beltran, A. (2018).** Sulfur dioxide as an effective antioxidant treatment in preserving grape quality during storage. Journal of Agricultural and Food Chemistry, 66(5), 1264-1271.[DOI: 10.1021/acs.jafc.7b06192]

Spanish Sources:

- **Gómez, M., & Vázquez, R. (2011).** Control de la calidad en la postcosecha de uva de mesa: el uso de SO2 y otros tratamientos en el raquis para prolongar la vida útil. Revista Española de Estudios Agrosociales y Pesqueros, 232, 97-106.[DOI: 10.1234/reseap.2011.232.106]
- **Zamorín, C., & Rodríguez, J. (2014).** Aplicación de dióxido de azufre en el tratamiento postcosecha de uvas de mesa para la preservación de la calidad del producto. In: Técnicas y procesos en la viticultura y enología. Editorial Universitaria, pp. 89-104.
- **Martínez, J., & Sánchez**, J. (2012). Uso de SO2 en la conservación postcosecha de frutas: Evaluación de su eficacia en la uva de mesa. Revista de Ciencias Agrícolas, 67(3), 123-130.

Italian Sources:

- **Sestili, P., & Galli, M. (2014):** Il trattamento con anidride solforosa nel controllo della qualità post-raccolta delle uve da tavola. Rivista di Viticoltura e di Enologia, 67(4), 283-290.This study examines the use of SO_2 in postharvest handling of table grapes, noting that SO_2 helps prevent oxidative damage to the rachis, preserving its green and fresh appearance, which improves the shelf life and market appeal of the fruit.
- **Giordano, G., & Cattaneo, A. (2015**): Uso di SO2 nella conservazione delle uve da tavola e l'effetto sul raquis. Frutta e Ambiente, 3(12), 45-50.This research focuses on the antioxidant properties of SO_2 in preserving the visual quality of the pedicel, reducing oxidation and maintaining the fresh, green color of table grapes during postharvest storage.
- **Pugliese, C., & Malossi, M. (2012):** Tecniche di conservazione delle uve da tavola: l'efficacia dell'anidride solforosa contro la degradazione ossidativa. Tecnologie Alimentari, 43(5), 118-122.The study explores the effectiveness of SO_2 in inhibiting oxidative damage, especially in the rachis, keeping the grapes fresher and greener by maintaining their antioxidant balance.
- **Caruso, G., & Salvo, M. (2016):** L'impiego dell'anidride solforosa per il controllo della qualità delle uve da tavola durante il trasporto. Annali di Chimica e Tecnologie Alimentari, 3(2), 83-90.This study discusses how SO_2 acts as an antioxidant during the transportation of table grapes, preventing oxidation of the rachis and improving the grapes' visual quality and freshness upon arrival at their destination.
- **Lombardo, M., & Vassallo, P. (2018):** Anidride solforosa nell'immagazzinamento delle uve: effetti sull'ossidazione e qualità del raquis. Agricultura e Conservazione, 7(6), 112-117.The article emphasizes the antioxidant role of SO_2, which prevents the oxidation of the rachis, thus maintaining the green appearance and freshness of table grapes throughout storage.



Source: Li et al, 2023

Anti Oxidant effect:

SO_2 promotes the accumulation of **phenolic compounds** such as (+)-**catechin**, (–)-**epicatechin**, and proanthocyanidins.

SO_2 promotes the accumulation of metabolites such as **cysteine** and **glutathione**.

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AgroFresh

How we cool the grape?

Main principal



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'A grape idea"



Cooling of the fruit in general

Convection

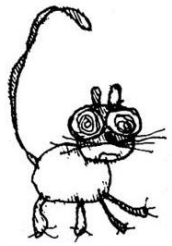
Cooling by convection in postharvest fruit and table grapes refers to the process of removing field heat by circulating cold air around the produce. The moving air transfers heat from the grape surface to the air, cooling the fruit efficiently and helping maintain condition, freshness, and shelf life.

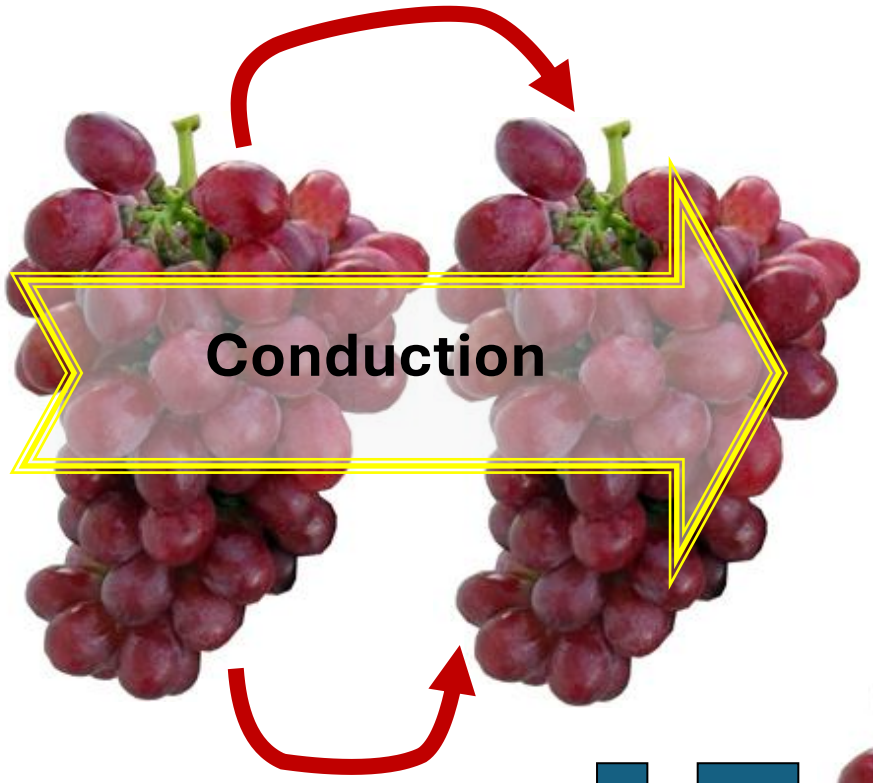
Conduction

Cooling by conduction in postharvest fruit and table grapes is the process where heat is transferred directly from the warmer fruit to a colder surface or surrounding medium through physical contact, helping to lower the fruit's temperature gradually.

In best postharvest practices for **table grapes**, **cooling by Convection** (forced-air cooling) is the **primary and most effective method**, accounting for about **90–95% of the total cooling process**. **Conduction** plays only a **minor role (around 5–10%)**, as it occurs mainly where the grapes or packaging directly contact cold surfaces. Efficient convection cooling ensures rapid and uniform temperature reduction, which is essential to preserve grape firmness, prevent decay, and extend shelf life, particularly the rachis.

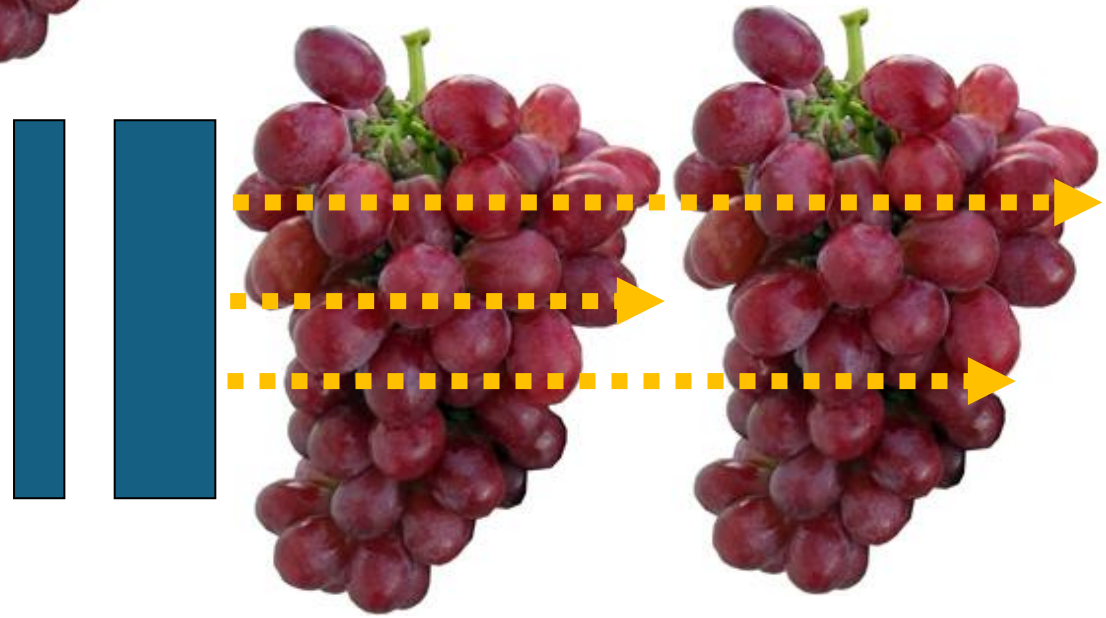






Poor or no box ventilation and connectivity
Little or no airflow
Long and inefficient cooling times
High dehydration of pedicels and/or rachis
Evident condensation
High probability of SO_2 damage

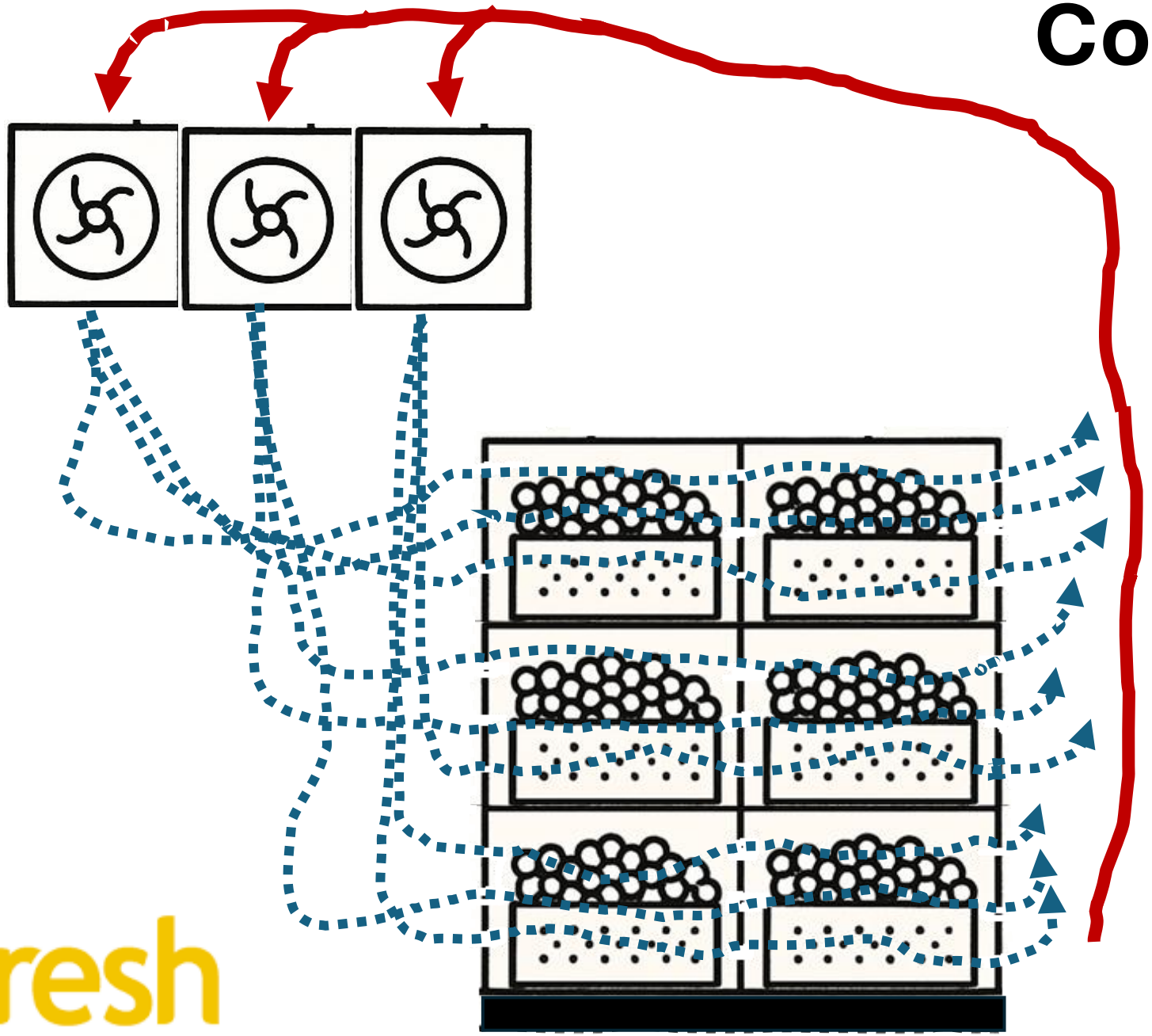
High box connectivity and ventilation
High airflow rate
Rapid and uniform cooling times
Low dehydration levels
Imperceptible condensation
Low or negligible risk of SO_2 damage



Convection

Fuente: algunos puntos tomados de L. Luchsinger 1999-2024, JP. Zoffoli y O. Salgado datos del día a día 2000-2025

Convection



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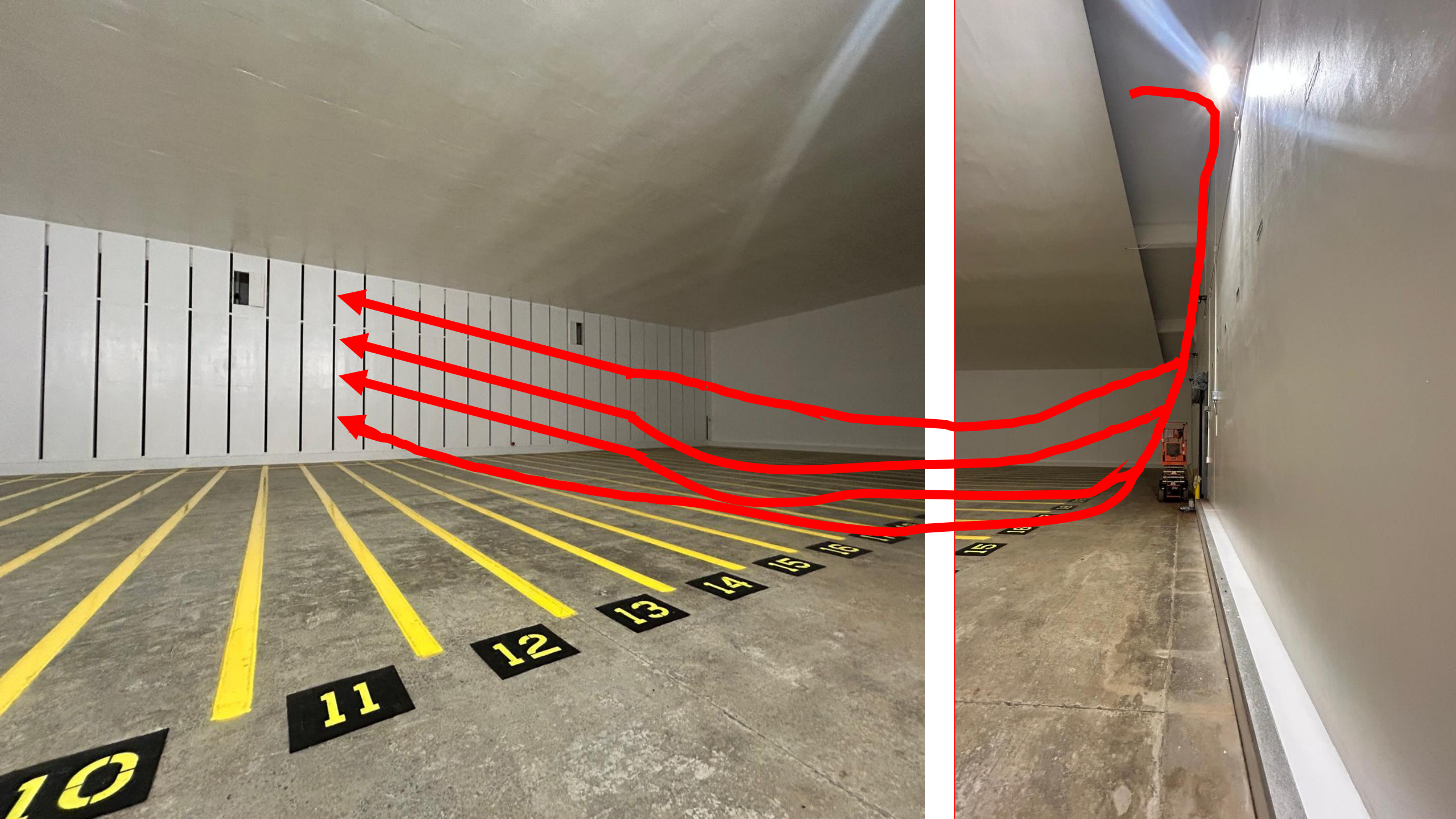
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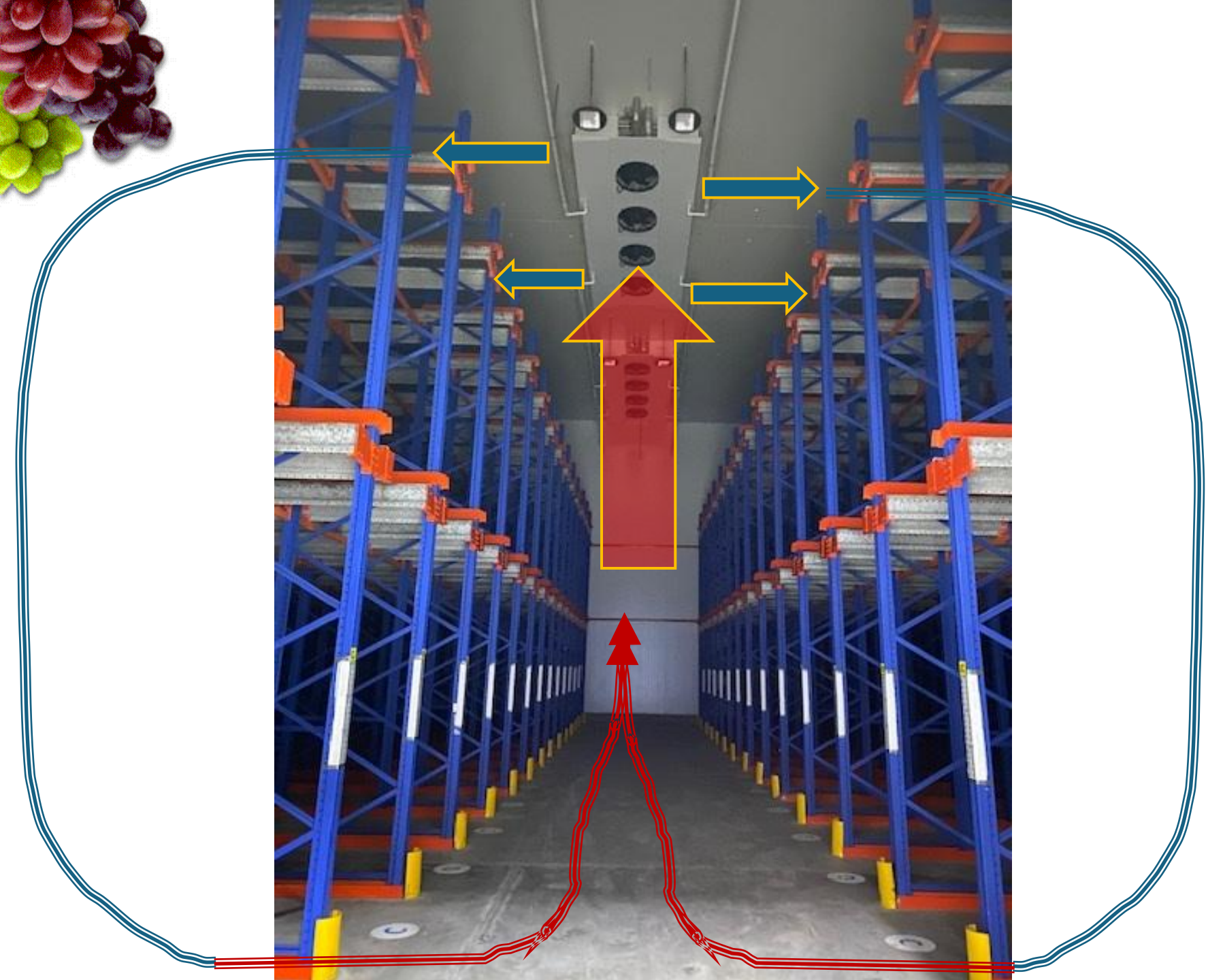

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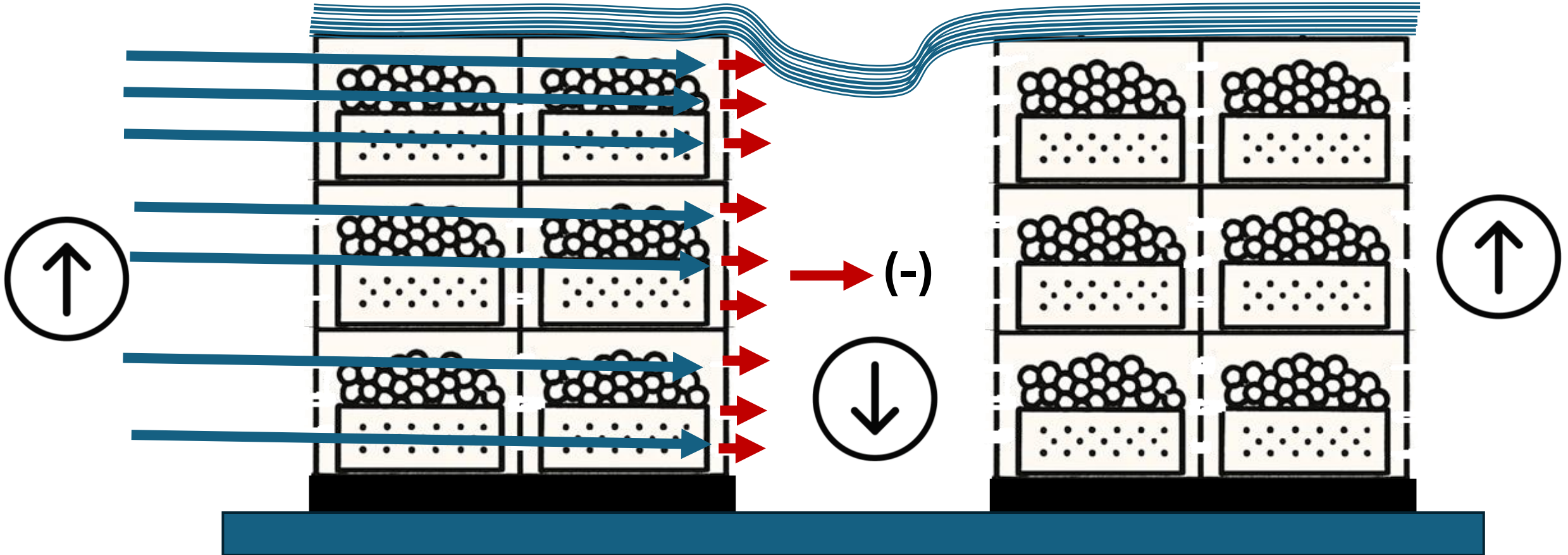
The principle of a fast pre-cooling or forced-air tunnel is **convection**. For this process, the **airflow connectivity through the boxes and the pallet** must be optimal, creating a **sealed or a vacuumed "tunnel" or negative pressure zone** that forces cold air to circulate through all the boxes and their internal volumes (sealing of the evident potential short cuts of the air).
This forced airflow removes both **field heat and physiological heat** from the fruit, compelling the cold air to pass through the produce and **exchange heat**, which is then absorbed and dissipated in the **evaporator coils** of the refrigeration system.













Key Table Grape features

Table grapes, as non-climacteric fruits with thin pericarp and succulent fruit tissue, are grown worldwide.

OPTIMUM TEMPERATURE

Berry storage at -1.0 to 0°C (30-32°F) is recommended. The highest freezing point for berries is -2.7°C (27.1°F), but freezing point varies (down to -3.0°C (26.6°F)) depending on SSC. A -2.0°C (28°F) stem freezing point has been reported.

OPTIMUM RELATIVE HUMIDITY

90-95% RH and an air velocity of approximately 20-40 feet per minute (FPM) is suggested during storage.

RATES OF RESPIRATION

(Of Grape Clusters, i.e. Berries and Stems)

Temperature	ml CO_2/kg·hr
0°C (32°F)	1-2
5°C (41°F)	3-4
10°C (50°F)	5-8
20°C (68°F)	12-15

Stem respiration rate is approximately 15 times higher than berry respiration.

To calculate heat production, multiply ml CO_2/kg·hr by 440 to get BTU/ton/day or by 122 to get kcal/metric ton/day.

RATES OF ETHYLENE PRODUCTION

<0.1 ml/kg·hr at 20°C (68°F)

RESPONSES TO ETHYLENE

Table grapes are not very sensitive to ethylene. However, exposure to ethylene (>10 ppm) may be a secondary factor in shatter.

Source: UC Davis Ca Table Grapes Postharvest Quality Maintenance Guidelines. Carlos H. Crisosto, Pomology Department. University of California Davis, CA. Joseph L. Smilanick Horticultural Crops Research Laboratory. USDA-ARS. Fresno CA

Pathological Phenomena



0^0C in pulp is not enough to suppress Botrytis growth.



According
L. Luchsinger (2017) Botrytis can grow even at -1°C, and the growth stop at -2°C too close or below the rachis freeing point.

Fungus associated to a Sour Rot Complex in Chile		
Effect of 0°C and the risk of developed growth of each fungus		
Spices	Minimum Pulp Temperature in 0°C	Risk of decay
Botrytis cinerea	**0**	**High**
Rhizopus stoloniffer	>5	Nil
Aspergillus niger	>7	Nil
Penicillium sp.	**0**	**Moderate**
Cladosporium herbarum	**0**	**Moderate**
Alternaria alternata	**0**	**Moderate**
Yeasts	>5	Low to Nil



Source :B. Latorre et al 2002

Note: fungus did not growth at average temperature they grow at a single point of temperature, so the average temperature at the cooling is a wrong concept (O. Salgado 2020)

Main post harvest diseases complex in Table Grape

Diseases	Organism	Management of the temperature	Infection
Gray mold	**Botrytis cinerea**	**- 0,5°C, grow at 0°C**	**Can direct degrade the tissue**
Blue Mold	**Penicillium expansum**	**- 0,5°C, grow at 0°C**	**Need wounds to penetrate the tissues, is a soft / watery tissue decay, then develop some whitish/Green/blue mold**
Black Bread decay	Rizopus stoloniffer	Can not grow at temperature below 5°C,	High virulence, fast growing at the high temperatures.

Source: JP Zoffoli 2015



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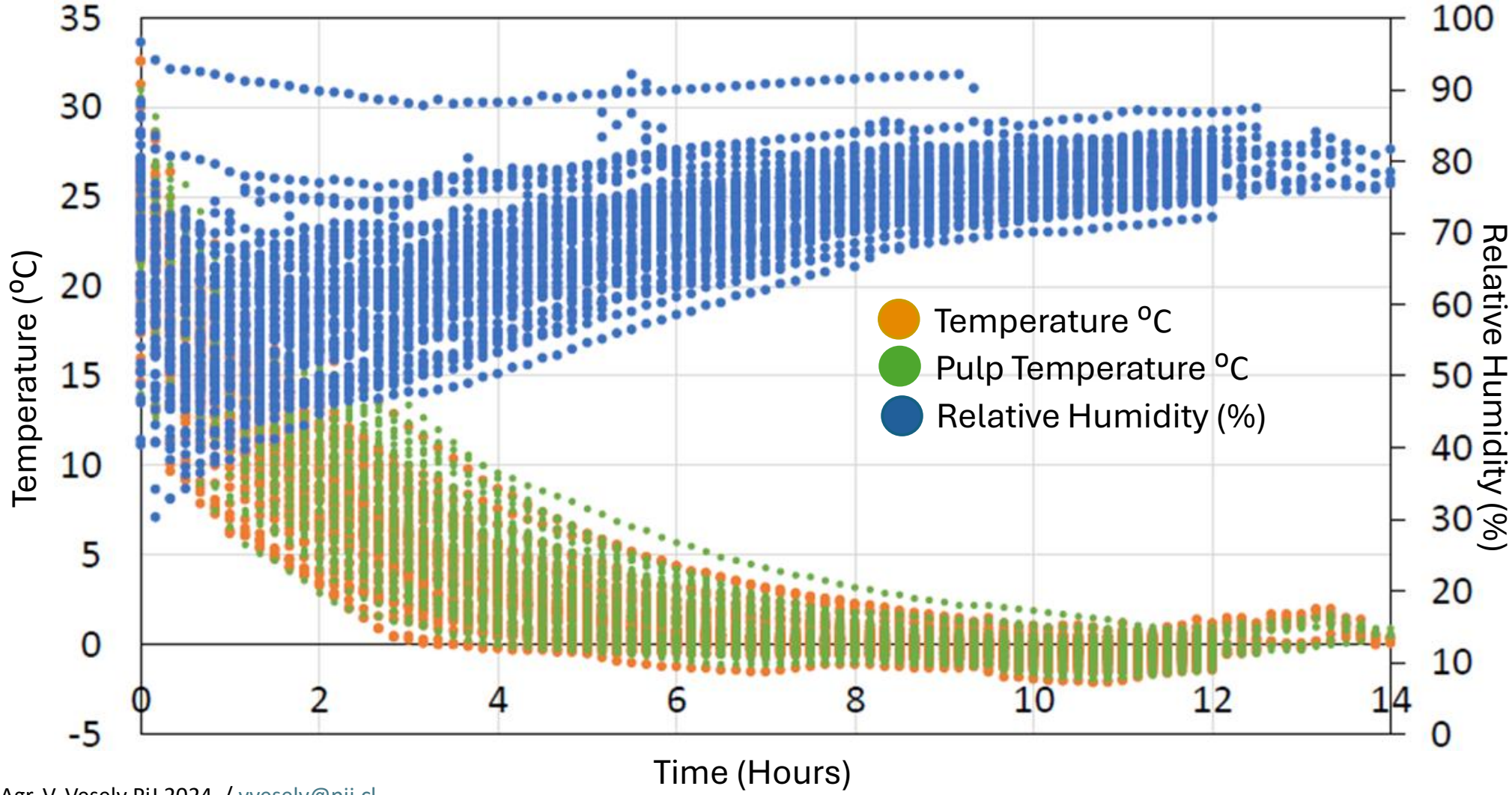


Source: Ing. Agr. V. Vesely PiJ 2024 / vvesely@pij.cl

The Box – Basic Principles

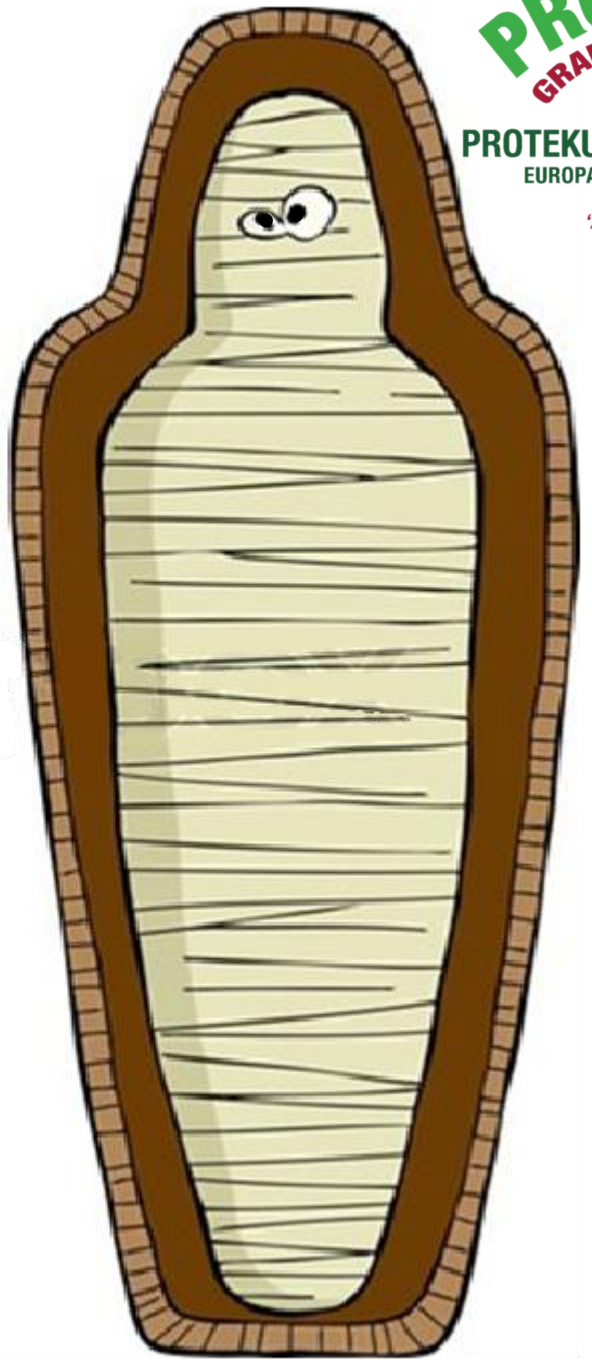
To contain the fruit and allow it to express its maximum agronomic and commercial potential within the technical and commercial timelines defined for each variety.

The design of packaging materials for long-distance transit must first consider technical aspects and logistical efficiency.

To comply with legal requirements (recyclability), quarantine regulations, and shelf size specifications of the destination market.

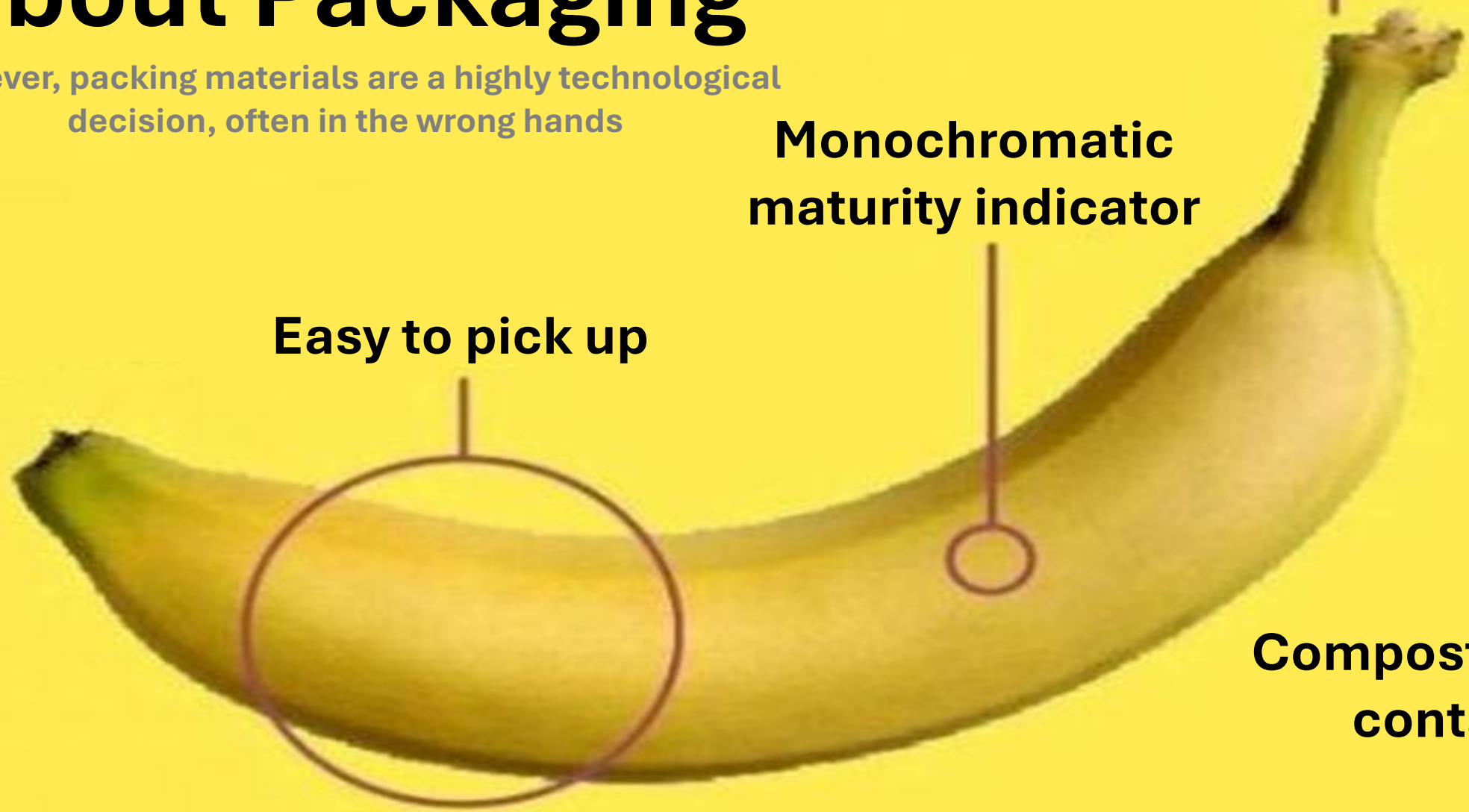
To meet general and specific commercial requirements (design, aesthetics, brand/branding).



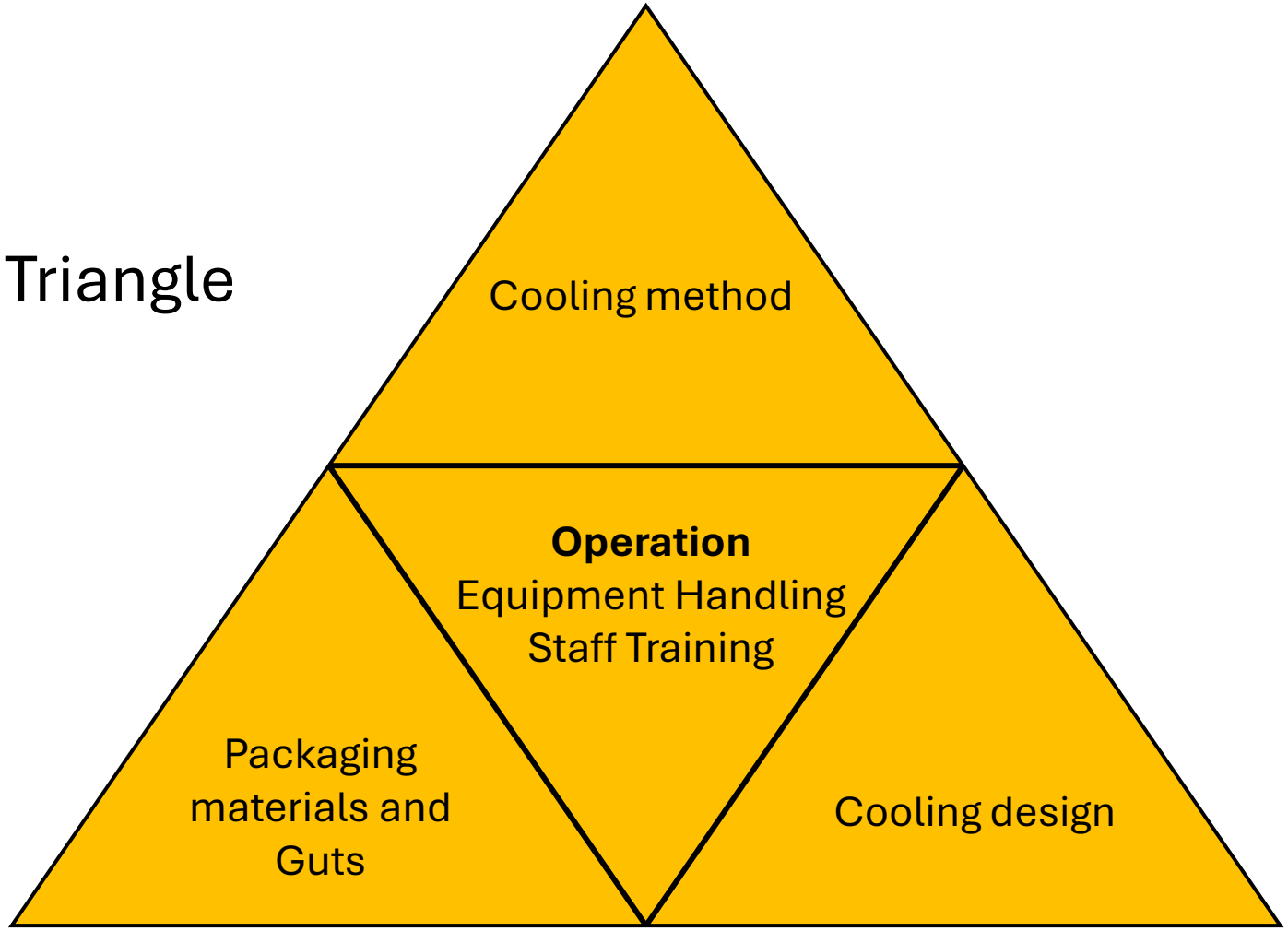


Nature also knows about Packaging

However, packing materials are a highly technological decision, often in the wrong hands

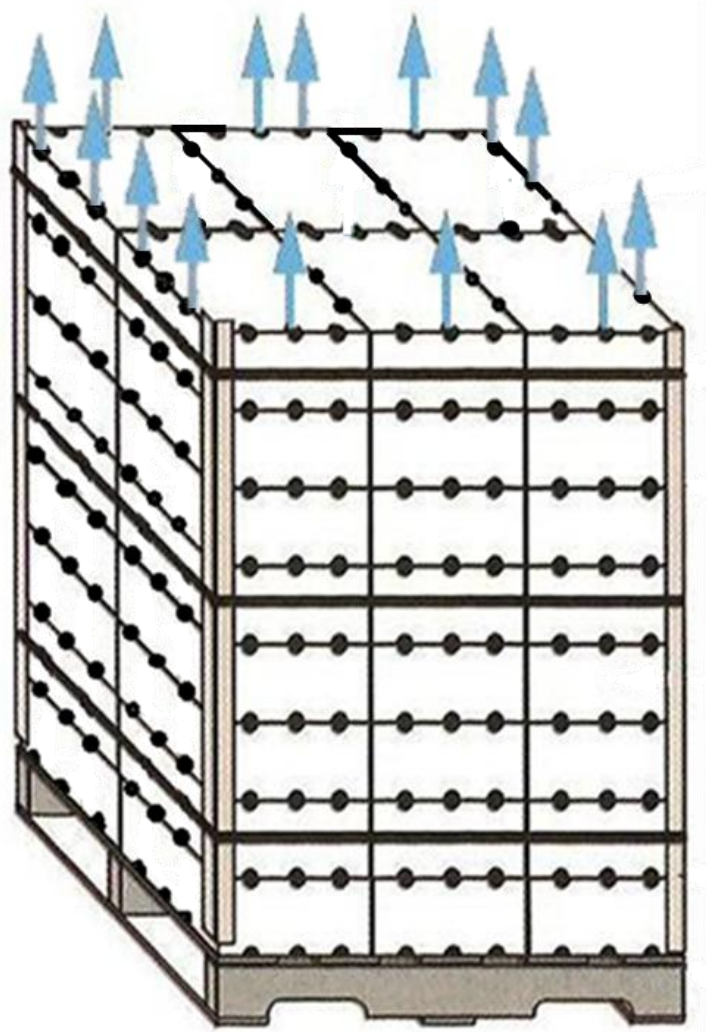


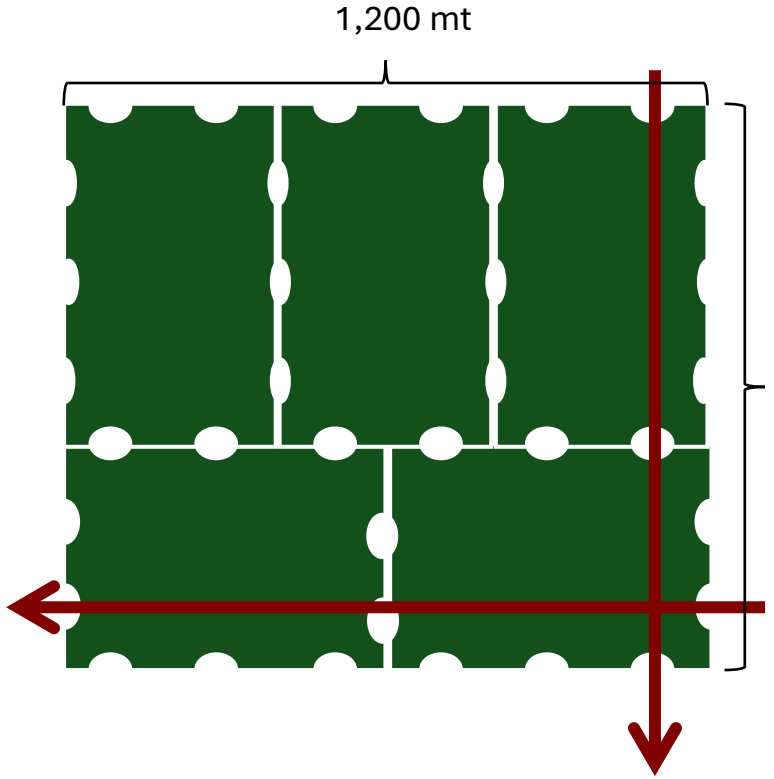
Cold Triangle

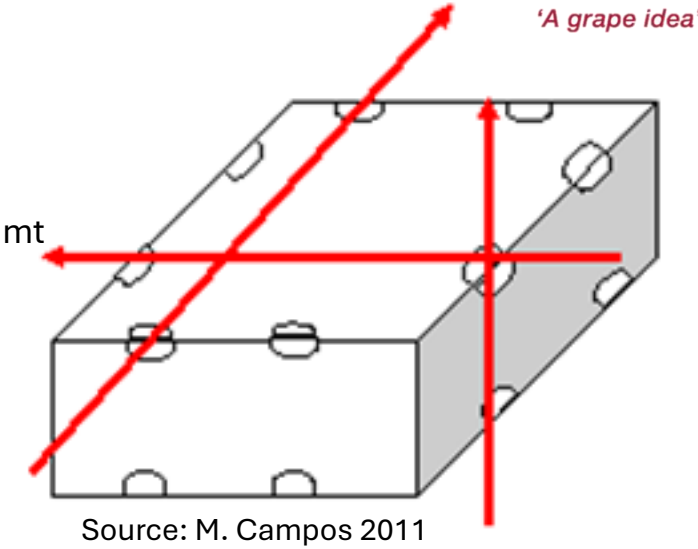


Source: adapted by O. Salgado from L. Luchsinger 2015

Bidirectional airflow

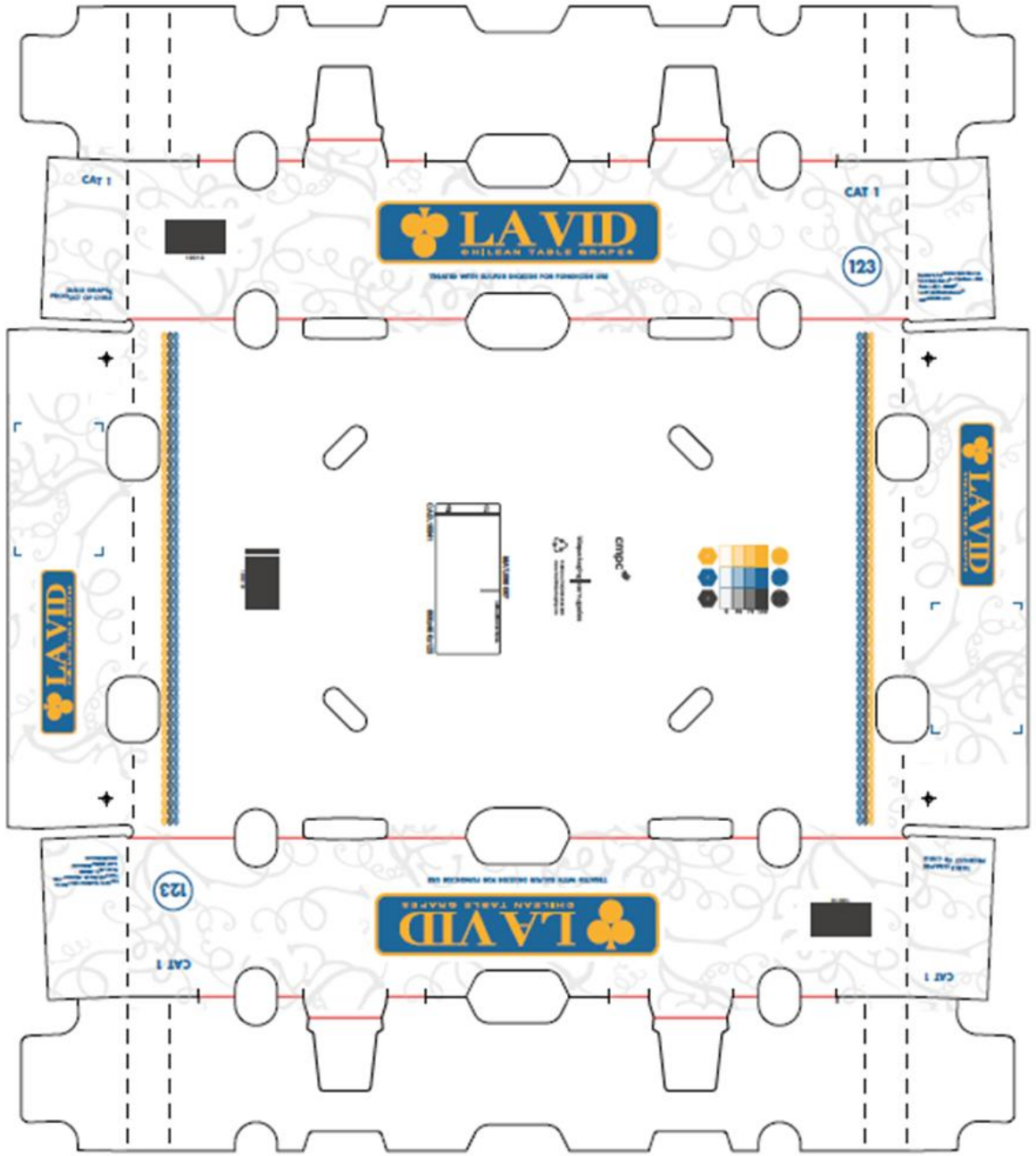






Source: M. Campos 2011

Airflow and box connectivity must be both vertical and horizontal, allowing for efficient cold air convection cooling.



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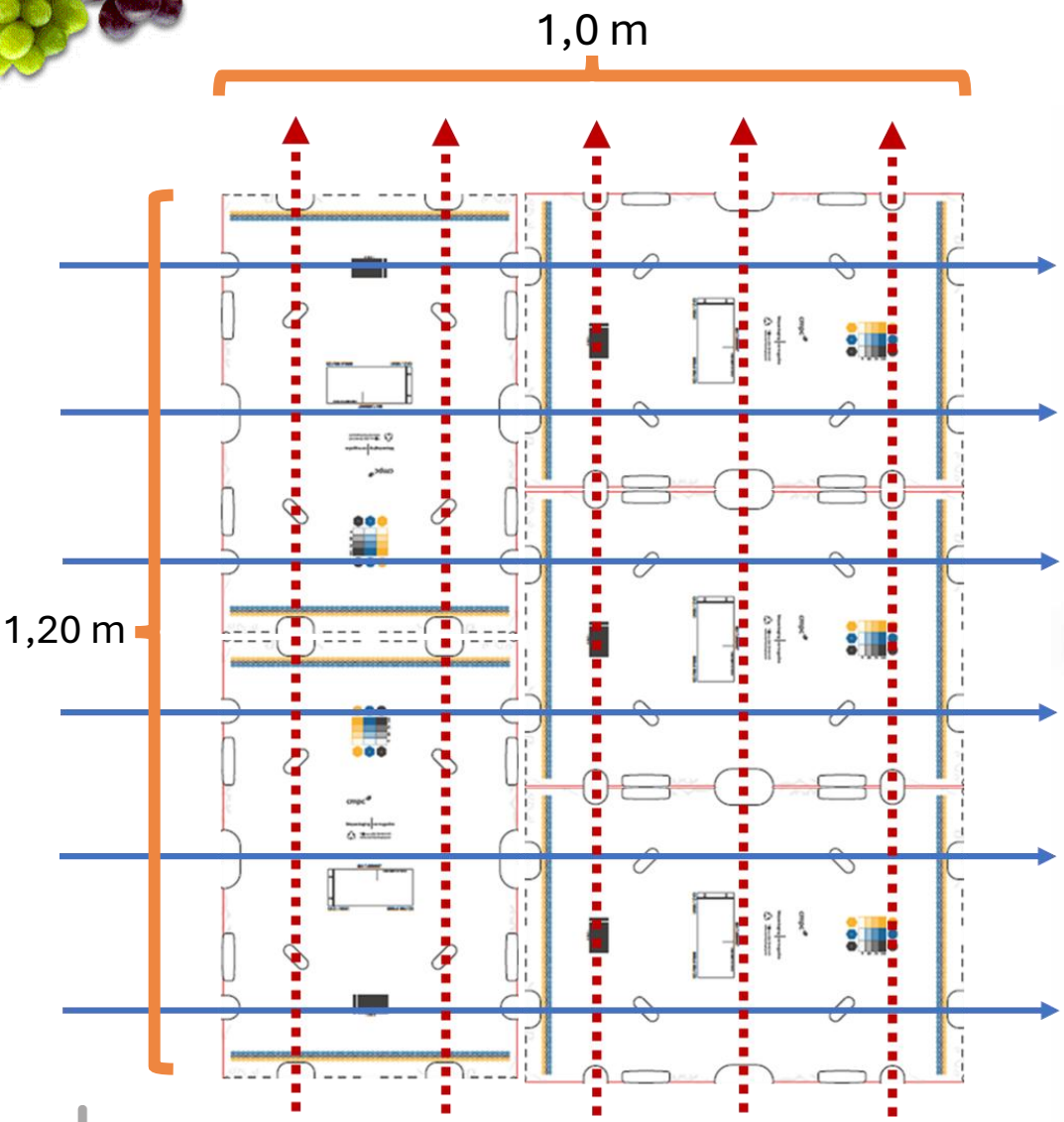
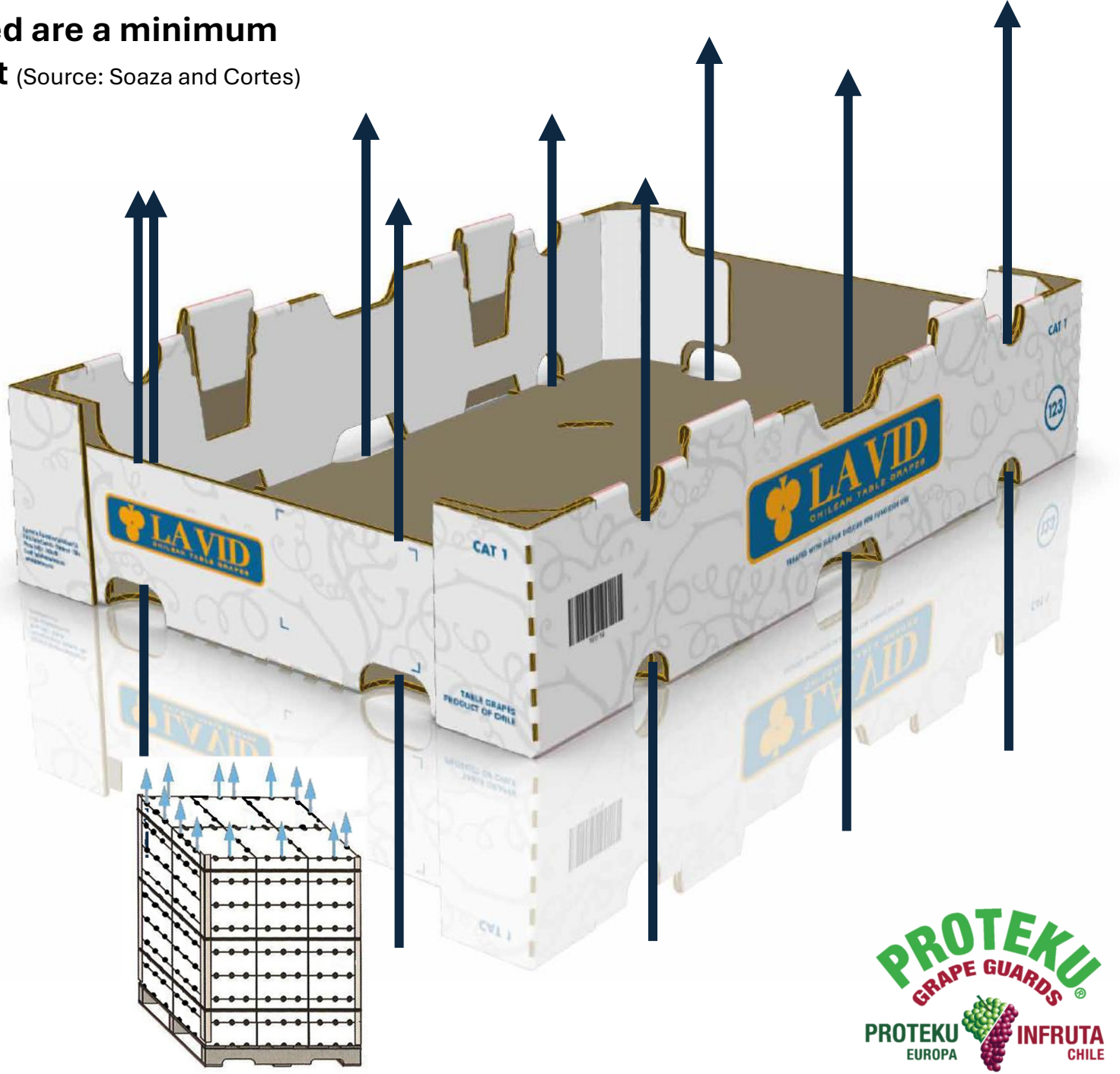
Internal free volume need are a minimum of 2,7 Liters per kilo of fruit (Source: Soaza and Cortes)





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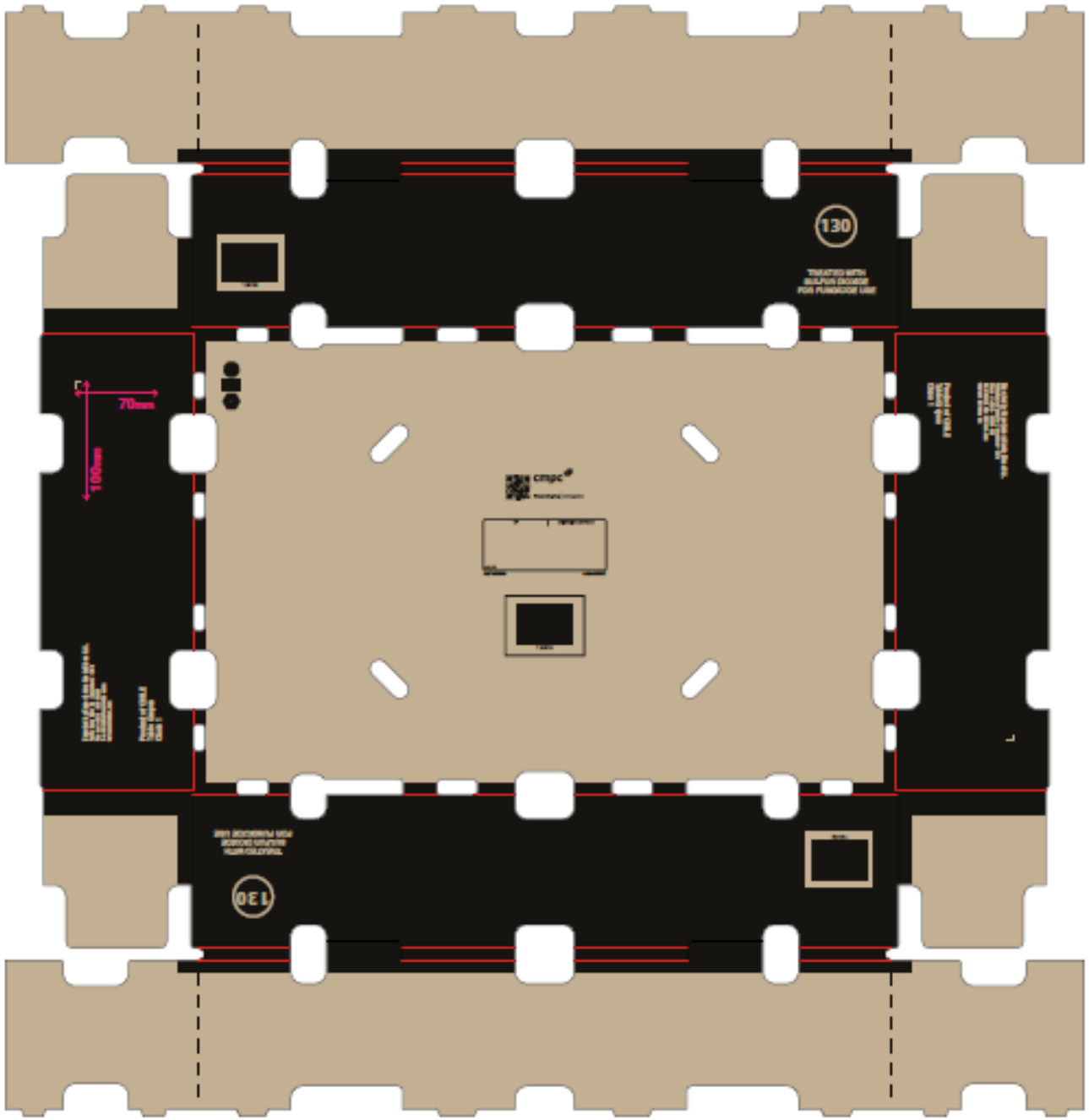

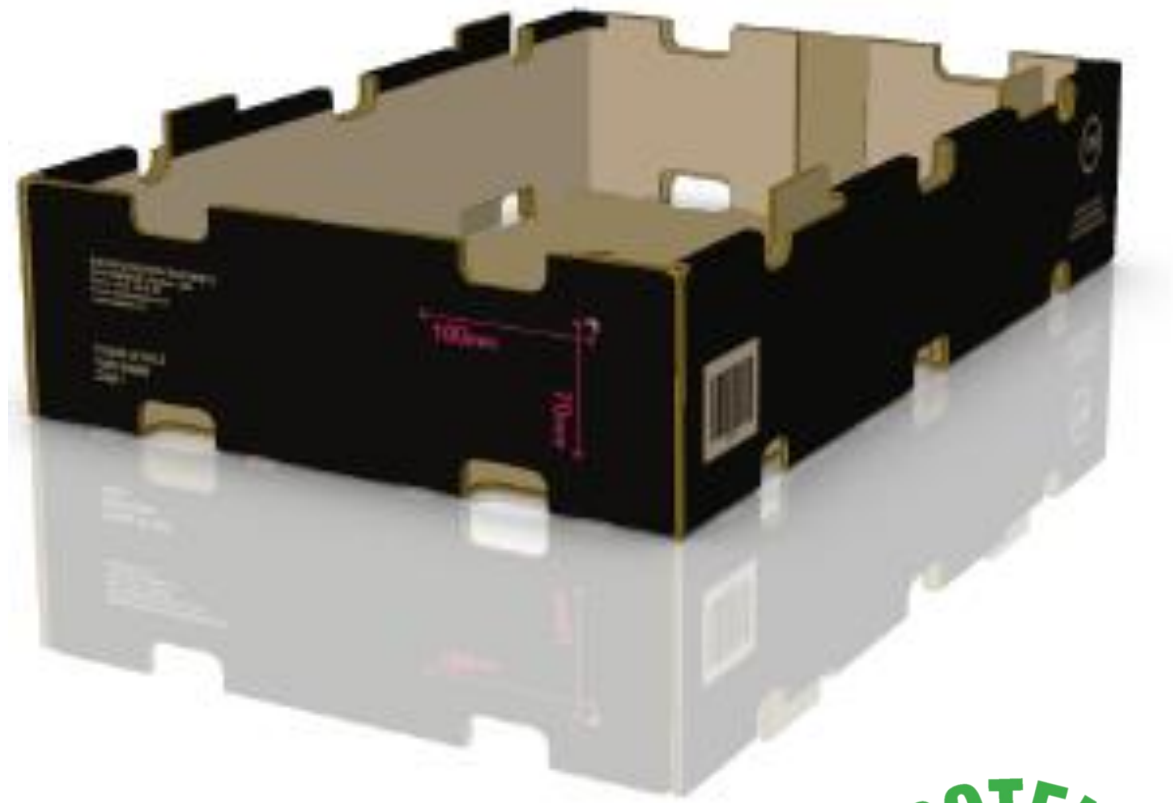

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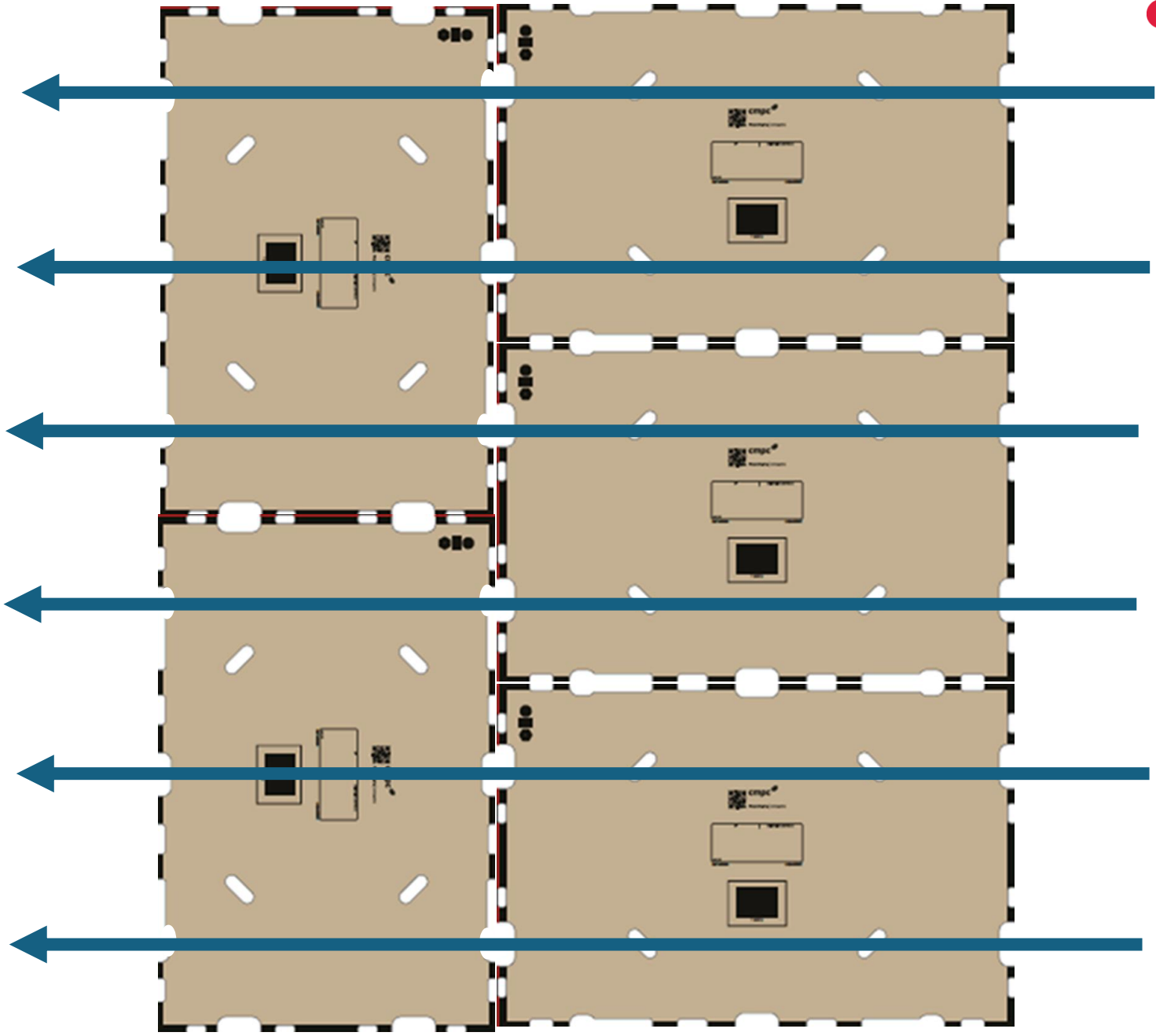

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Lateral vents in export table grape boxes have minimal effect on convective cooling, regardless of the level of airflow connectivity between boxes or within the pallet. This is because the grape liner bag, together with the internal packaging components (papers, absorb pads, MAM sheets, polybags, or clamshells), restricts proper airflow both within each box and between boxes. Consequently, these perforations or vents do not significantly contribute to maintaining cold temperatures—already limited under vertical airflow conditions—in containers, vessel holds, or trucks, and often weakened the box strength.



Ventilaciones laterales, restan resistencia a la caja al romper los vectores entre los ángulos de la caja





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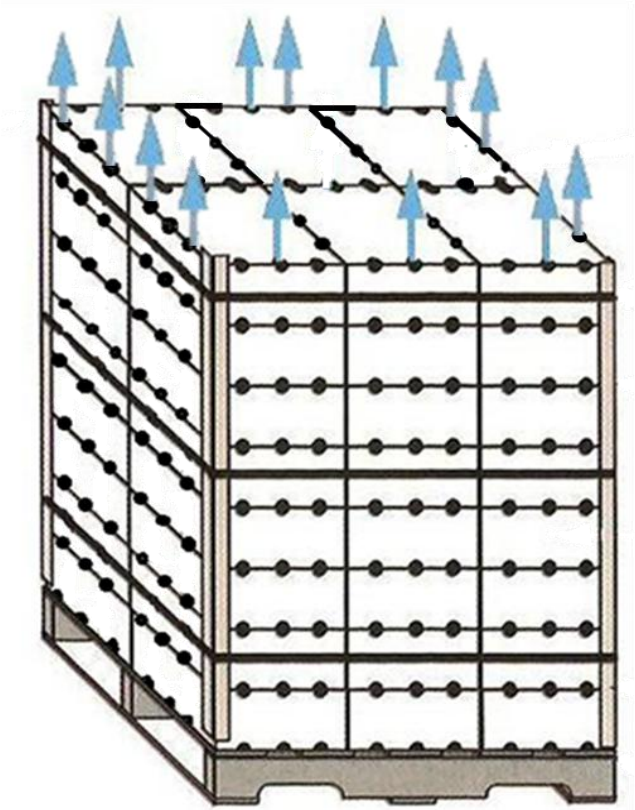

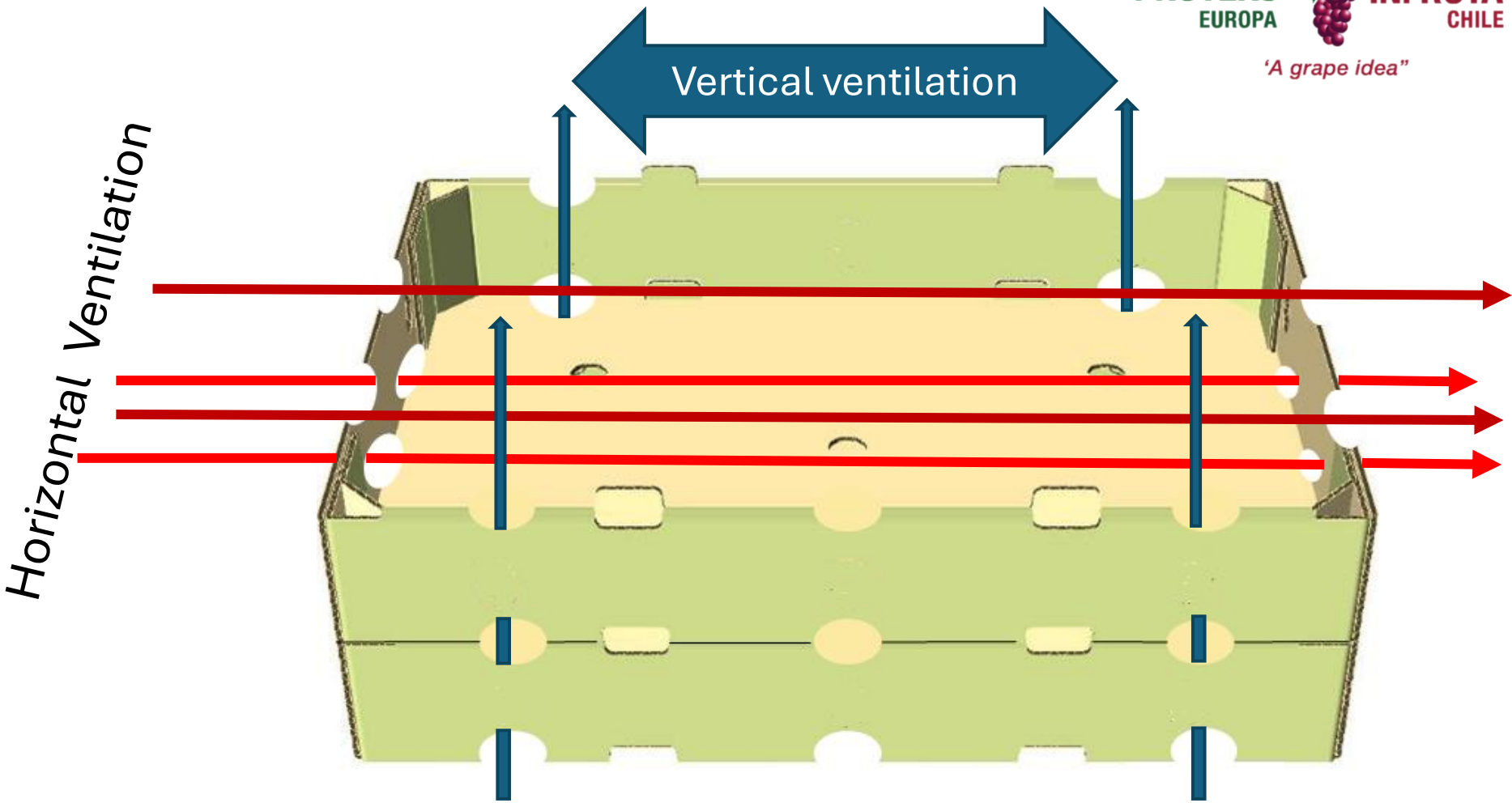



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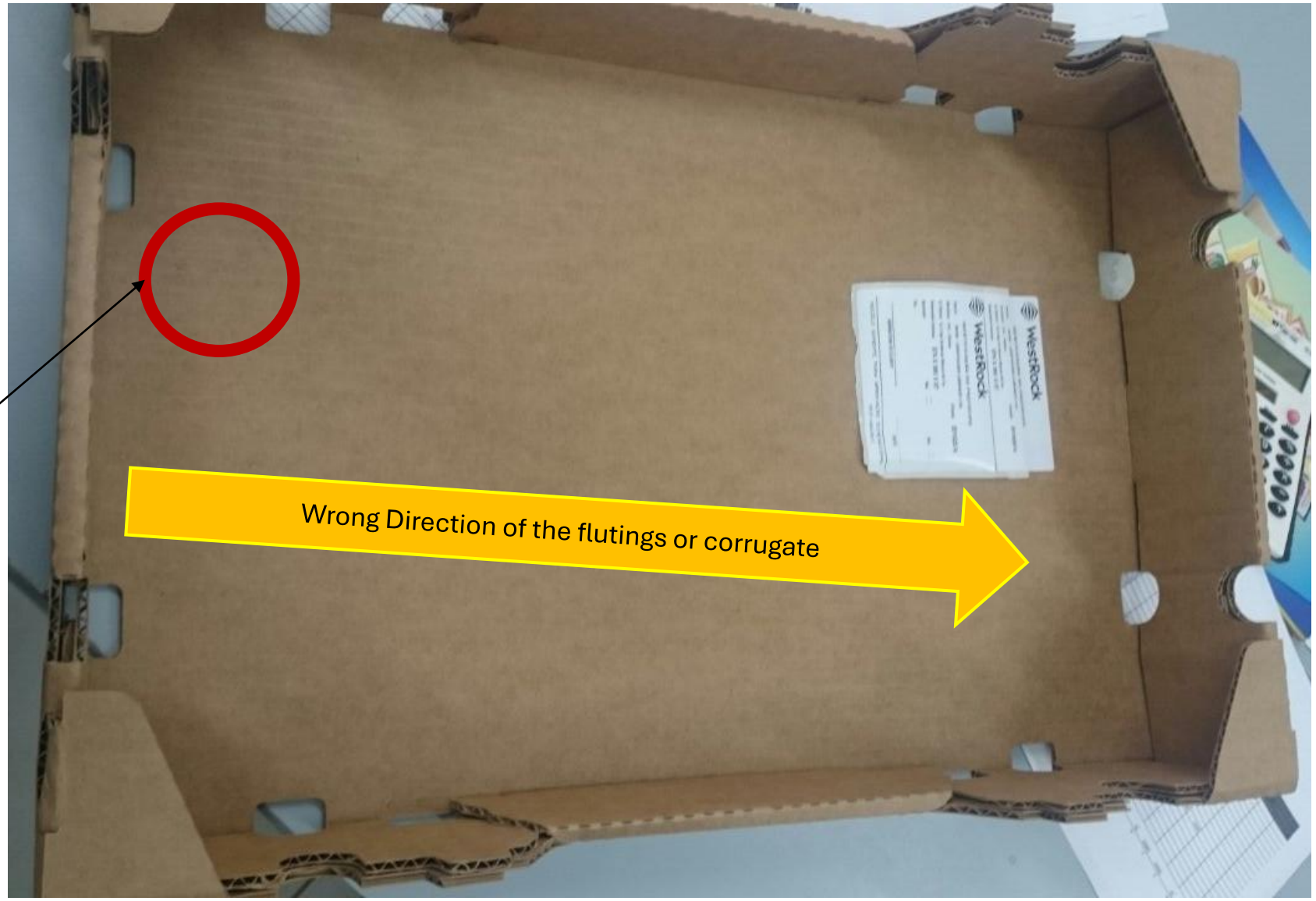





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Using boxes with the wrong corrugation direction in 40 × 60 grape packs can cause the box bottom to buckle or sag, compressing the berries and leading to bruising during handling and transport."

Source: Pic O. Salgado in UK 2024

Source: Pic O. Salgado in UK 2024





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Source: M. Campos 2016

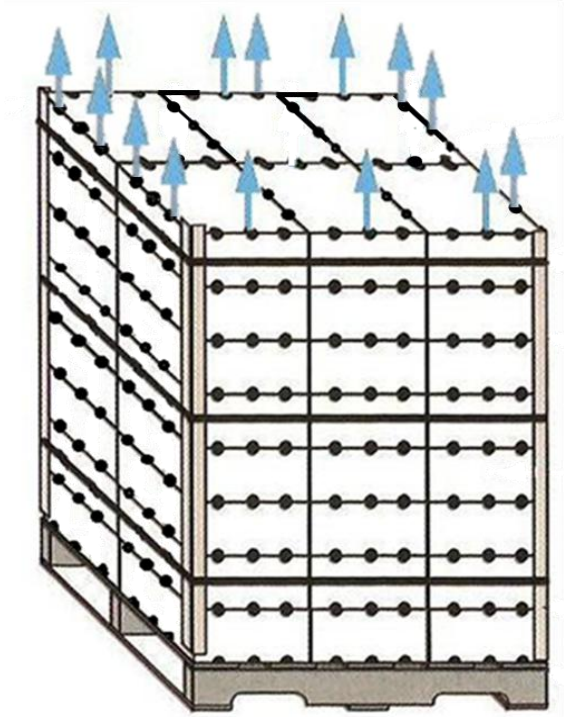








Carton seal for preserve airflow inside pallets



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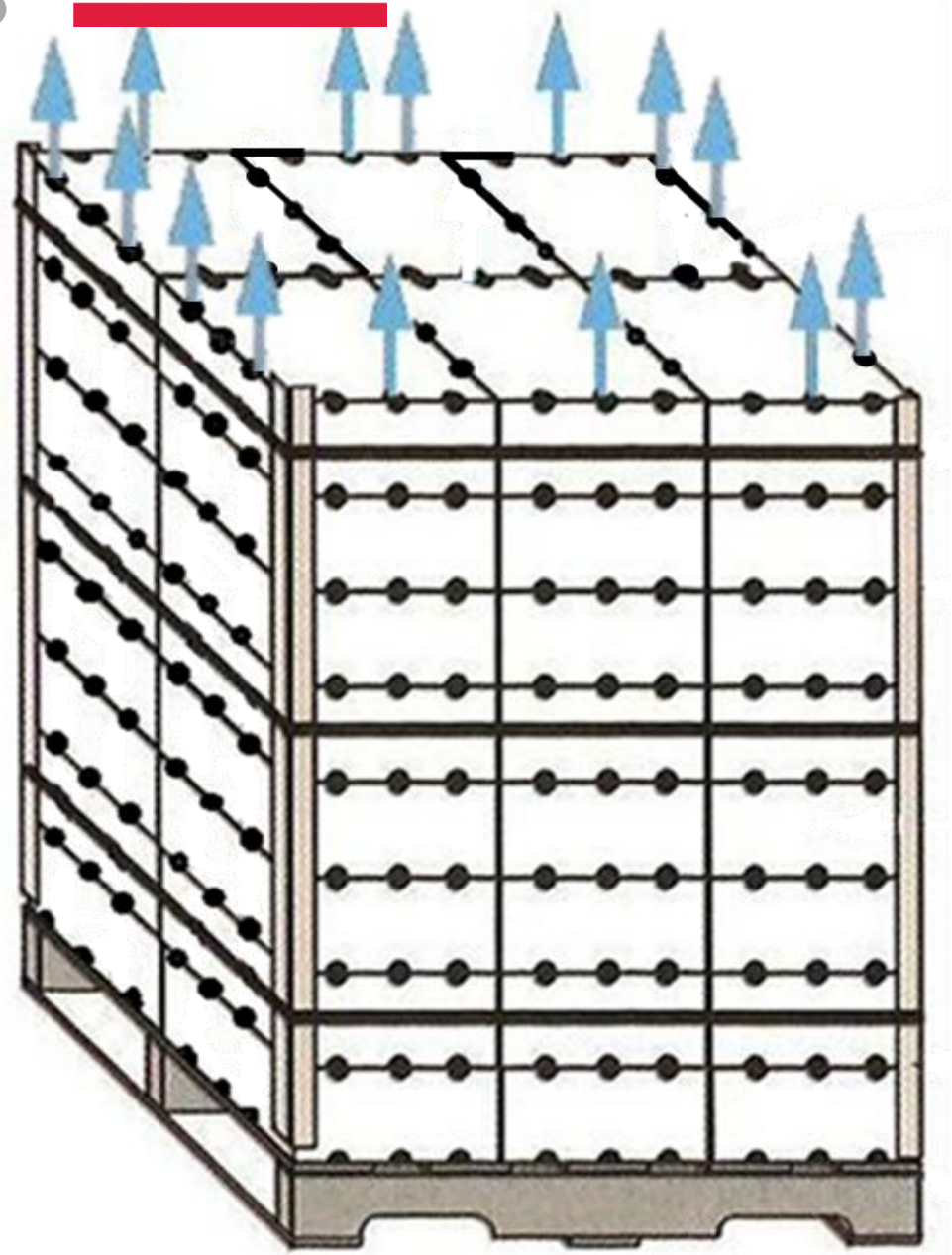

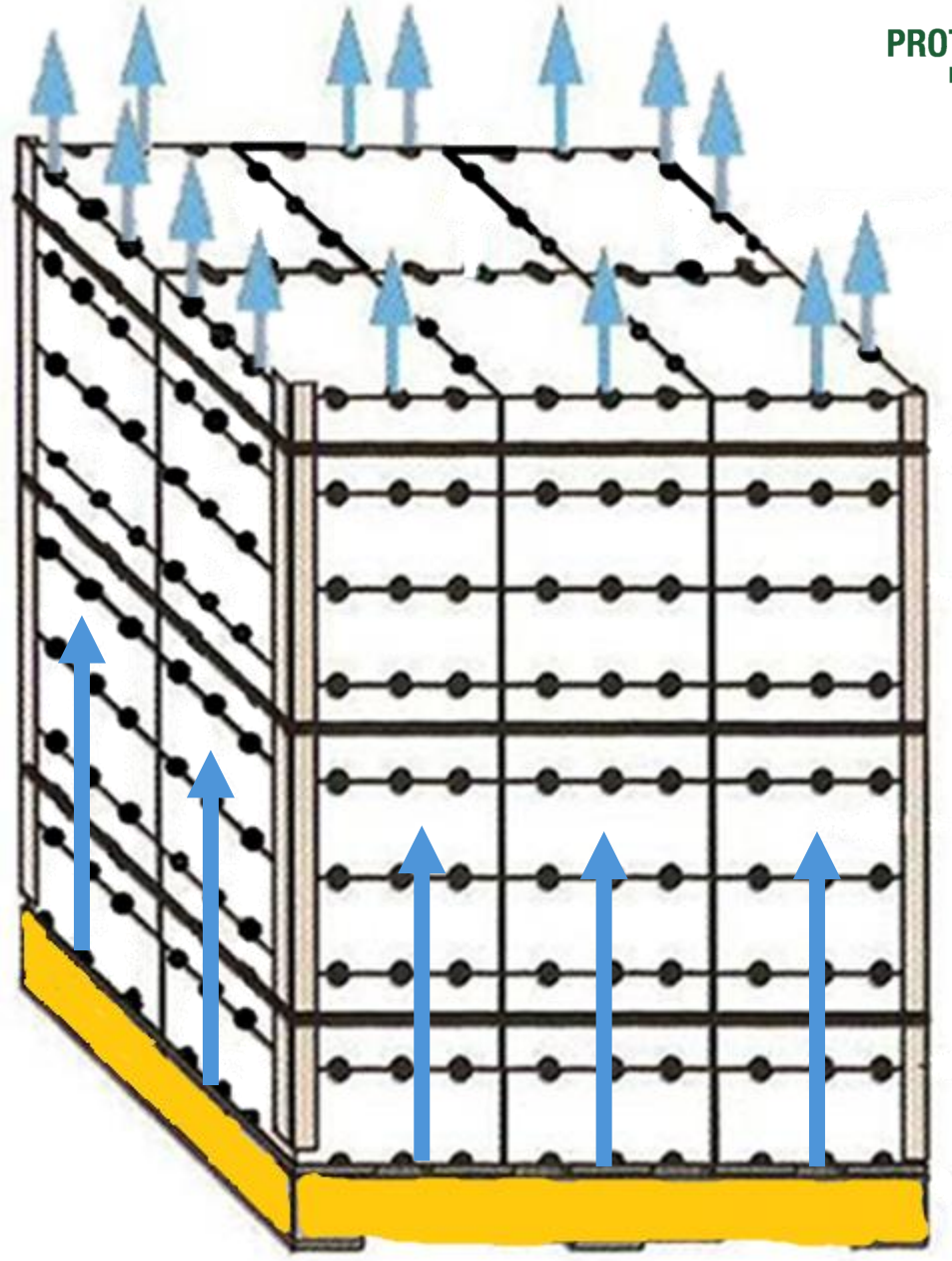




Table Grapes
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Red Globe C822
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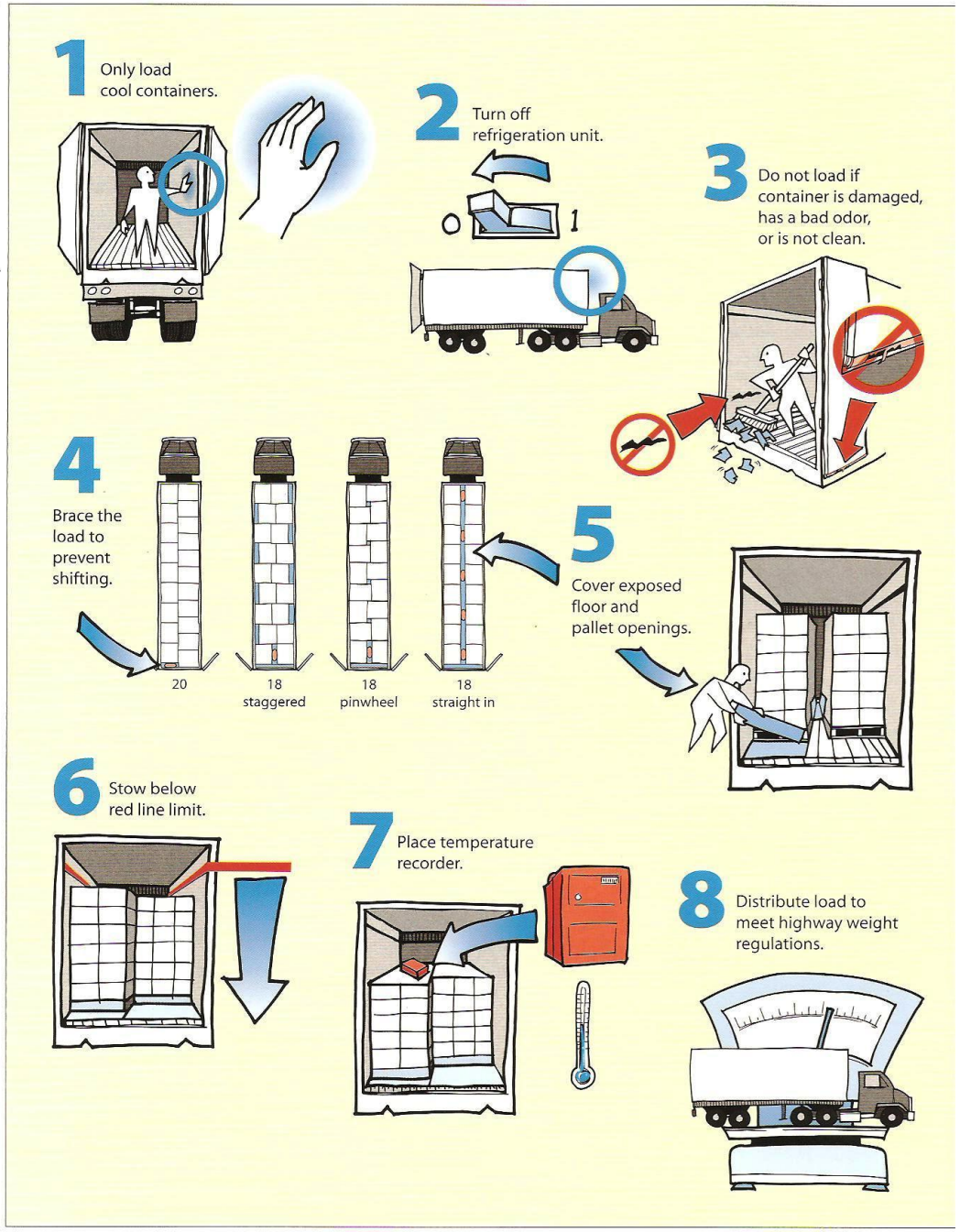
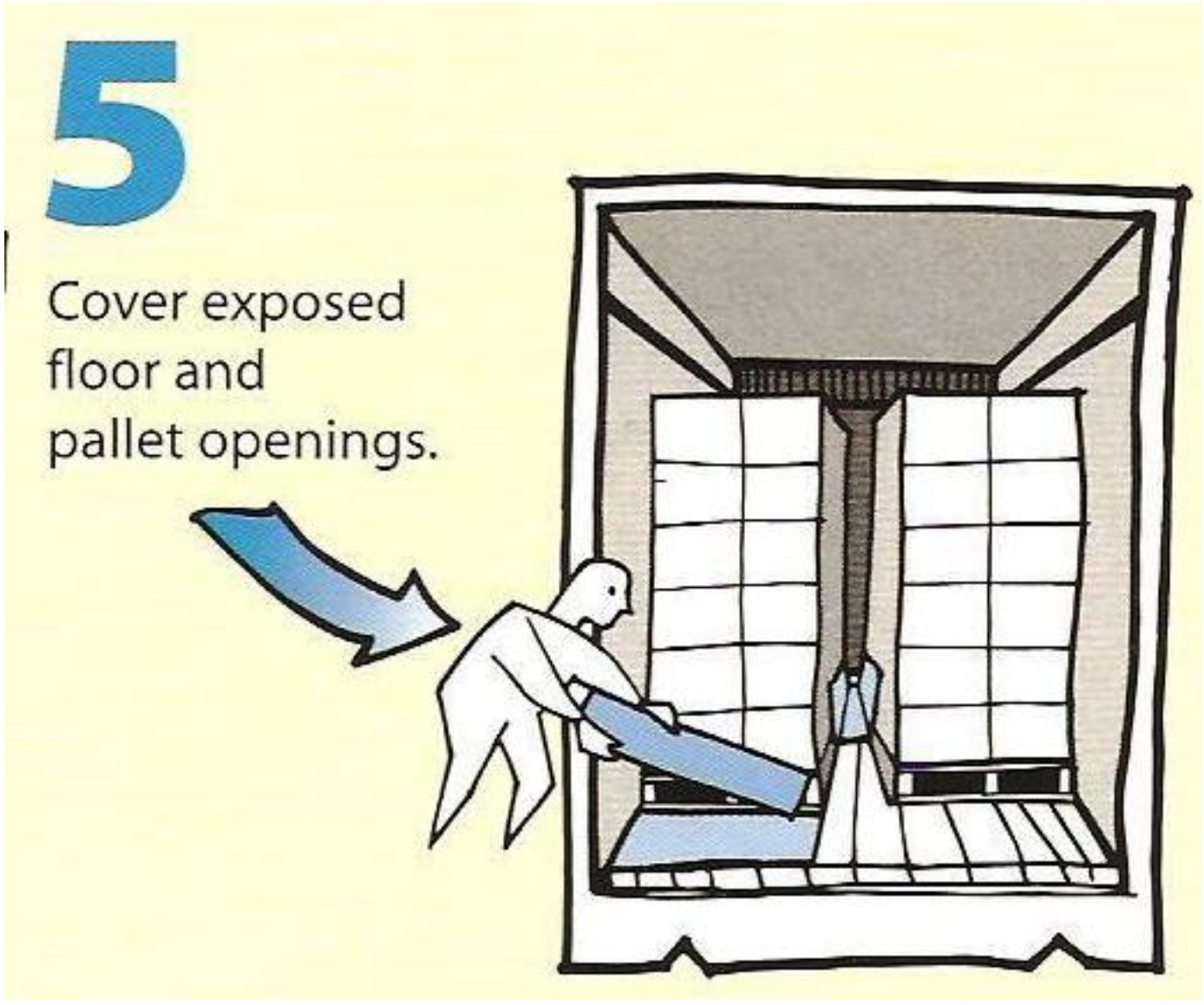
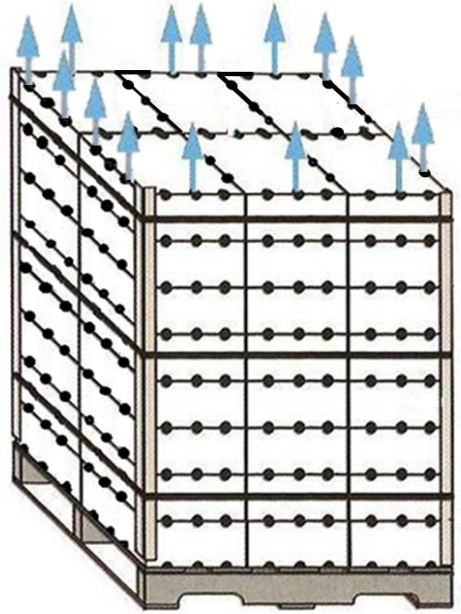


Figure 4. Loading marine containers.







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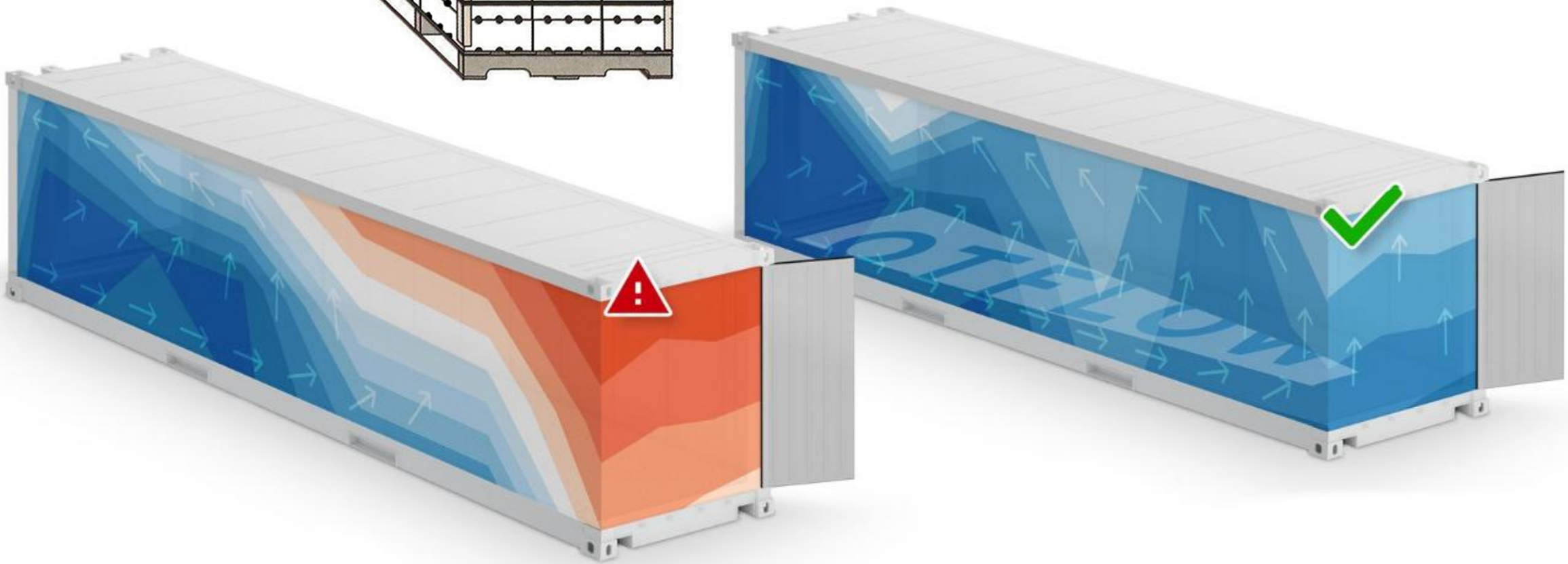
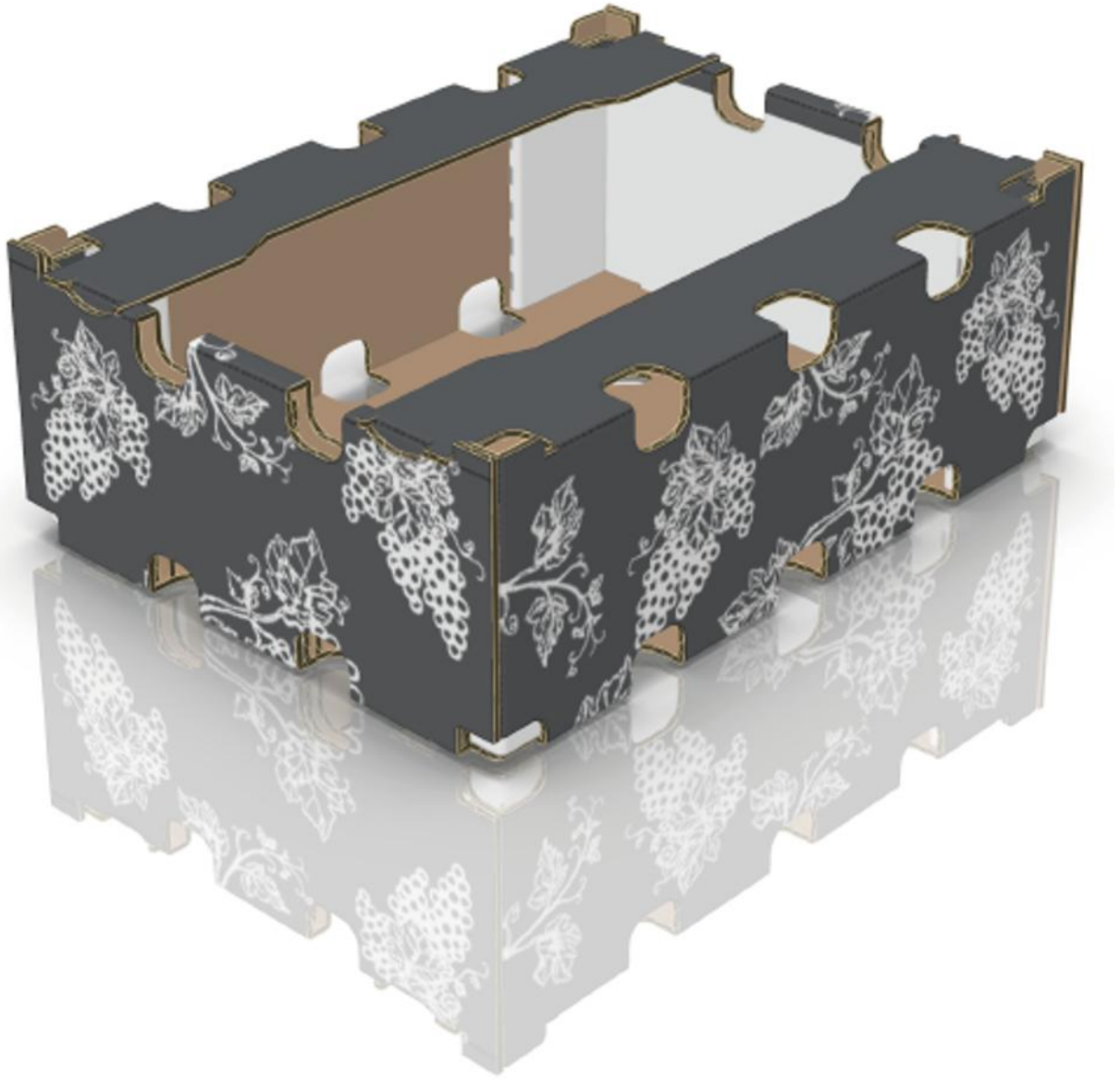


https://www.otflow.com/es/como-funciona/





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Cardboard layers that reduce the interior volume of the box, some authors follow **≥2,707.00 cm^3 / kilo or 2.3 to 2.7 liters per kilo of fruit**. The larger the caliber of the berries (in mm), the greater internal volume that is required.

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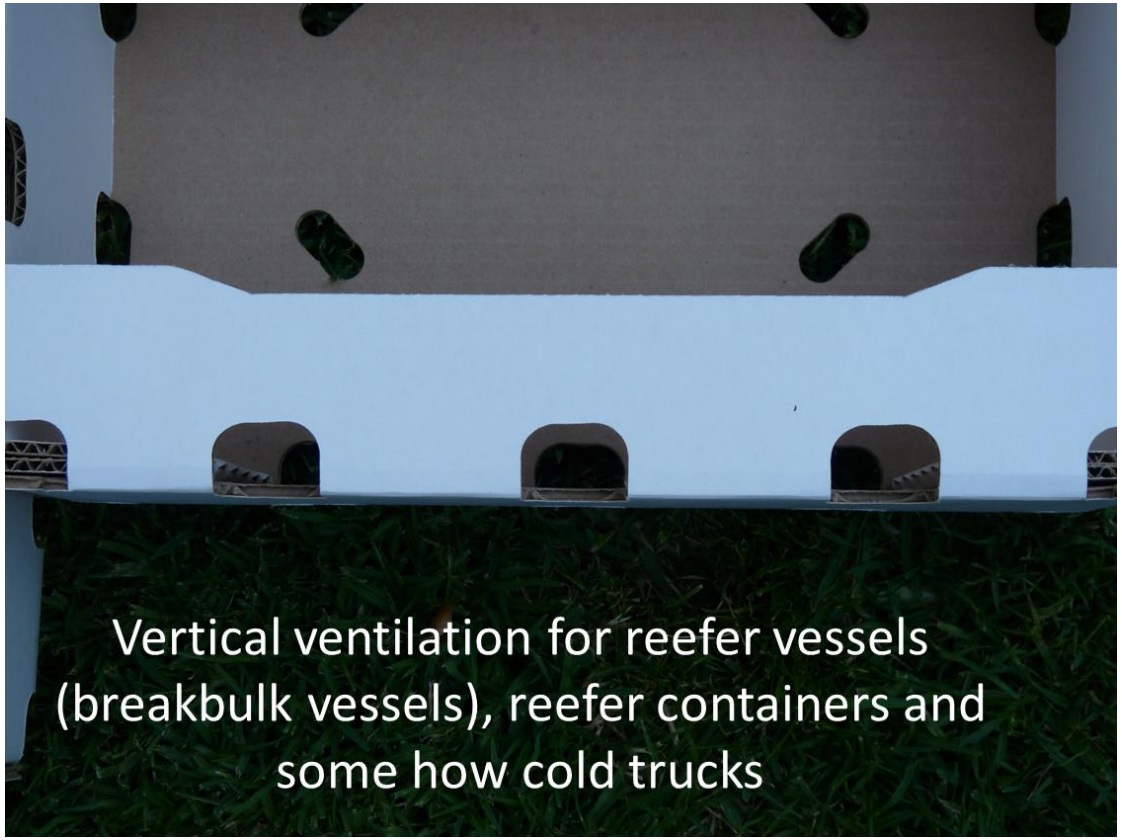

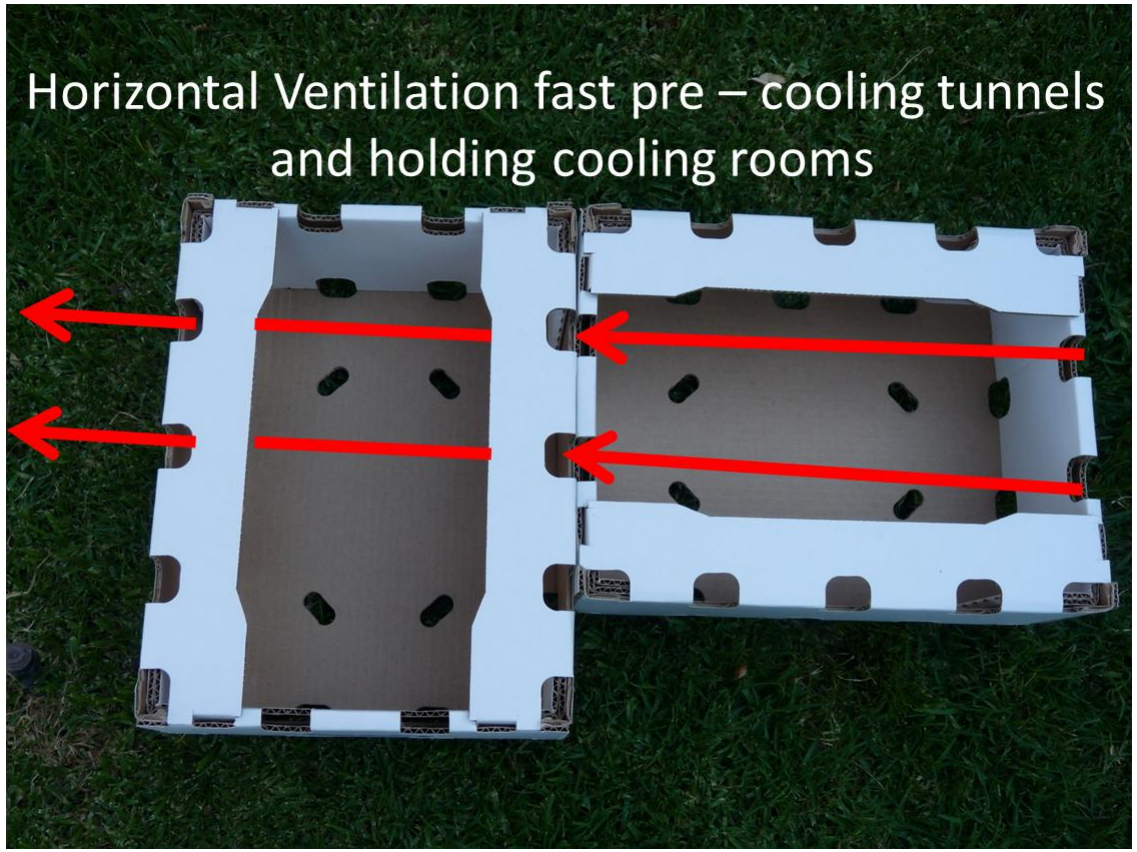

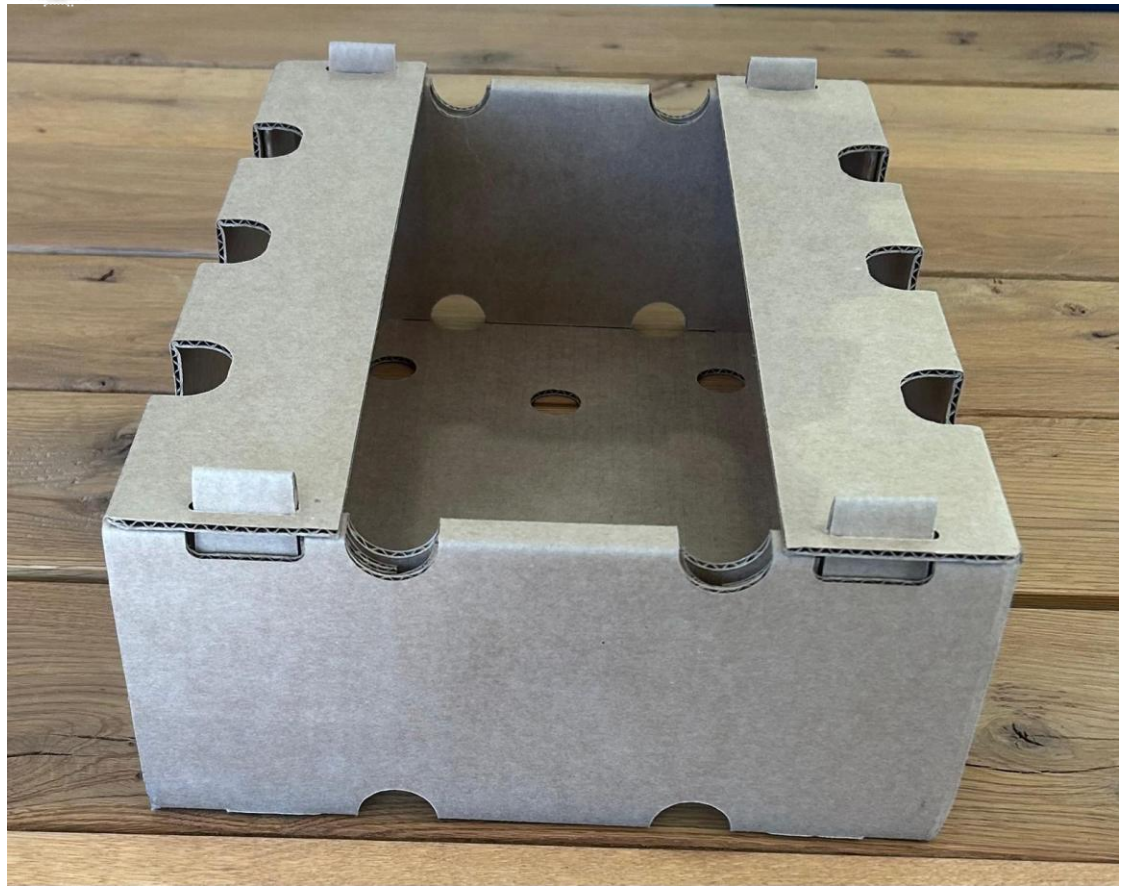

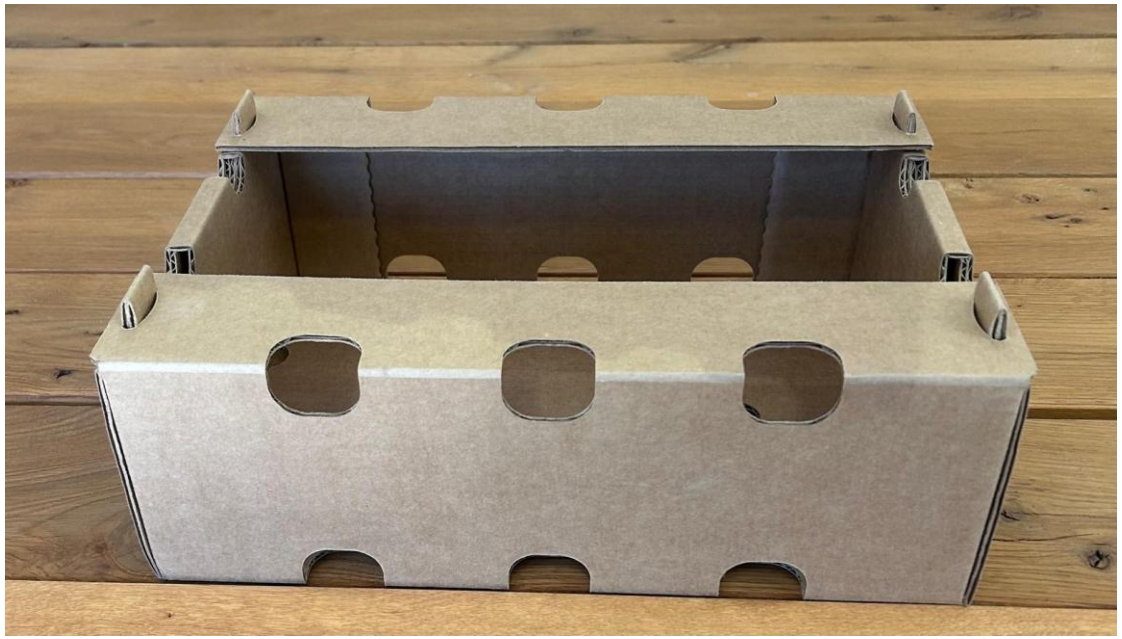

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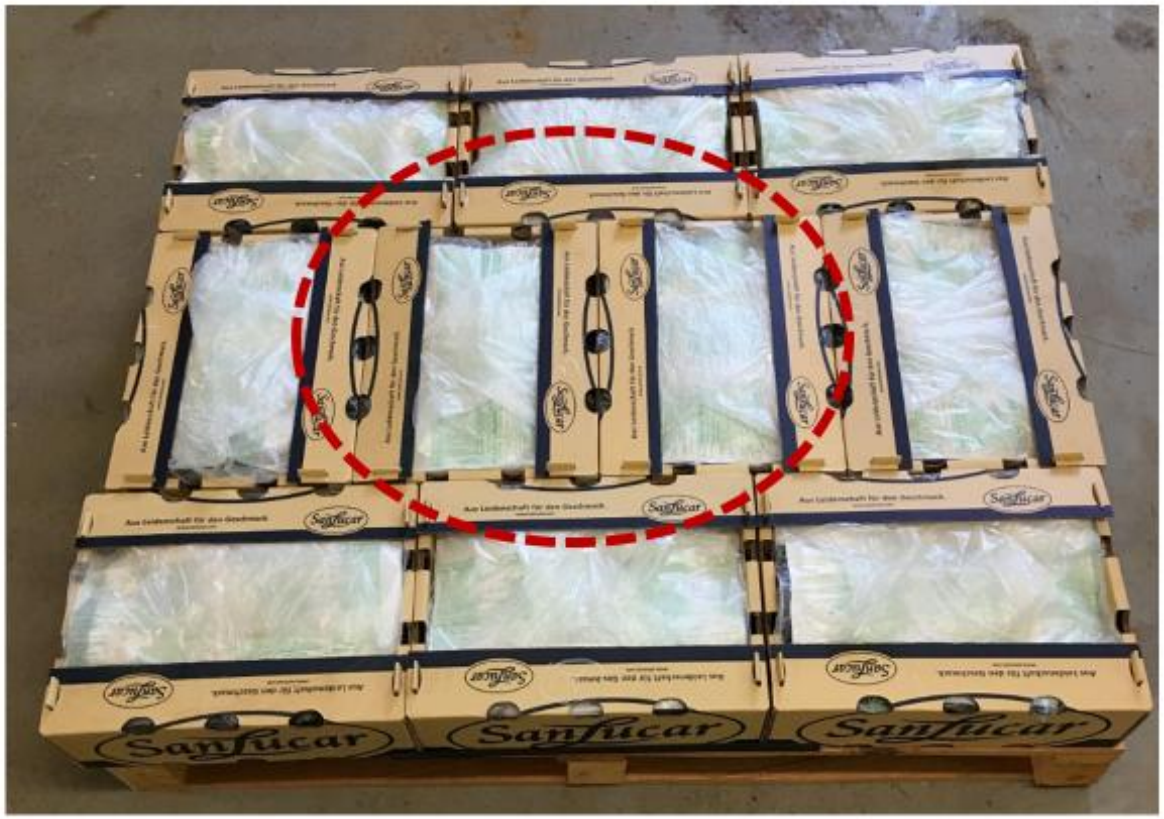
Cross ventilation form the top and the bottom of the box





Standard two blind boxes format

Keep using for all market the one blind box staking format

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Proper sealing of the grape liner bag, with sufficient tension to avoid fruit damage and prevent the bag from opening (*tear off*), ensures efficient cold-air convection, helps maintain high relative humidity, and prevents the loss of sulphur dioxide (SO_2).



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Source: J.M. Lepe December 2025

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RED SEEDLESS GRAPES
RAISINS ROUGES SANS PEPINS
INGLEBY FARMS
PULL TO TEAR AWAY AND DISPLAY

The Liner bag

The concept of a liner grape bag refers to its ventilated surface area—specifically, the total area of all perforations (macro or micro) in relation to the bag's overall surface area. It is not the size of individual perforations that matters, but their cumulative area. This is typically expressed as a percentage of the total surface area of each liner bag or ventilated area in %.

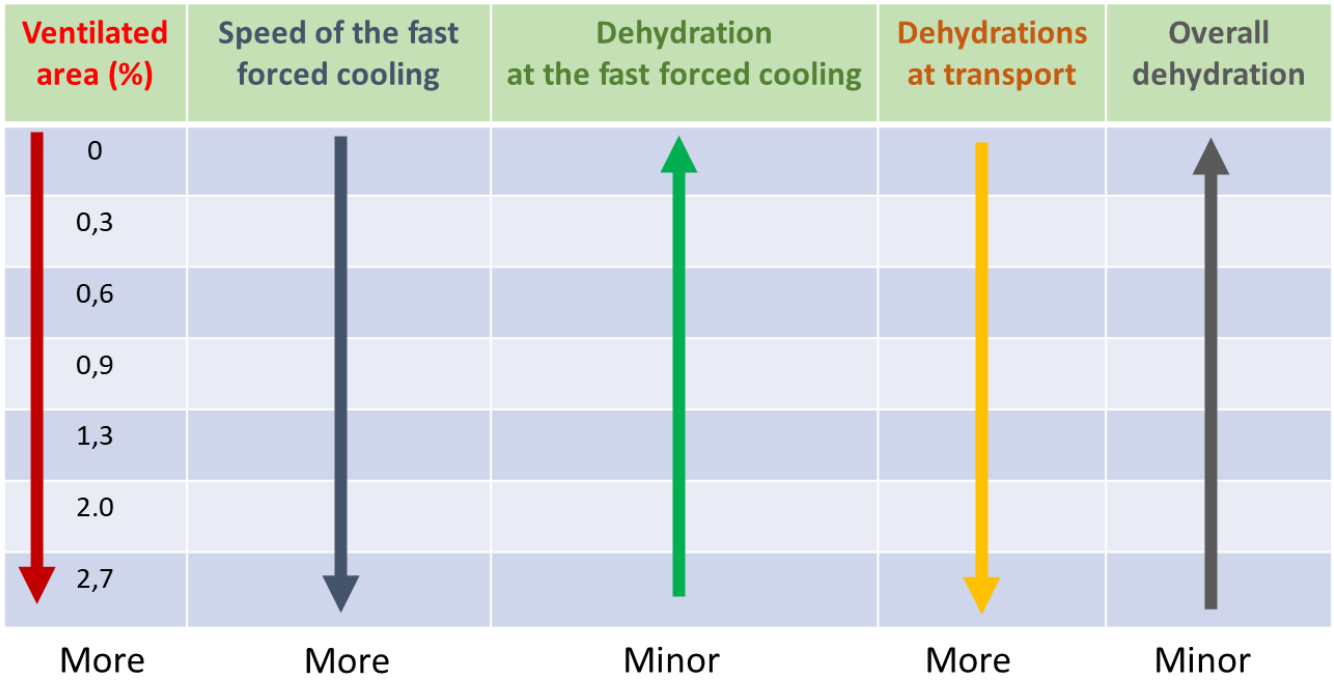
Is the location of these perforations important?

Yes, it is—but only after resolving horizontal and vertical airflow between boxes through the pallet, which is essential for enabling **cooling by convection** rather than by conduction. Once airflow through the packaging is optimized, the placement of perforations can be adjusted for maximum efficiency.

However, due to the wide variety of box formats, standardizing perforation placement becomes quite challenging.....explore the same ventilated area but micro ventilation.

Therefore, the priority must be to optimize box and pallet cross ventilation.

Conceptual principle of liner bag ventilation



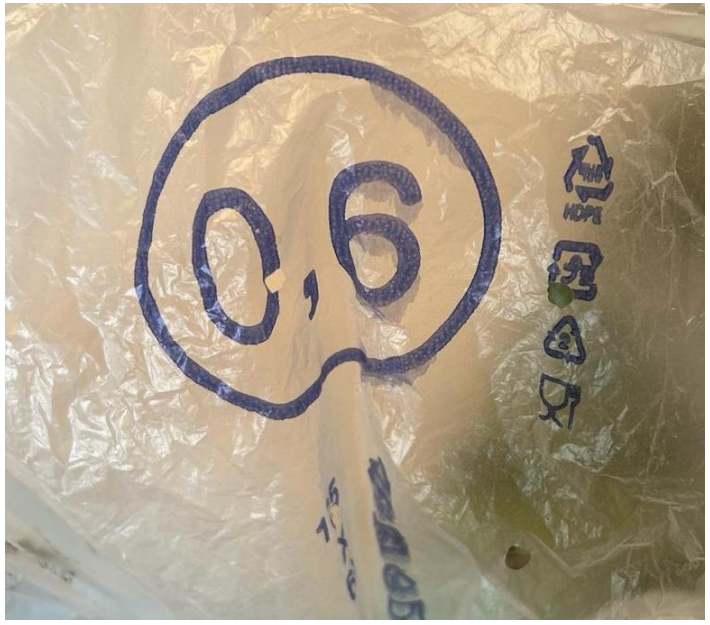
Source: adapted by O. Salgado from L. Lunchsinger 2022

Liners with different ventilated areas















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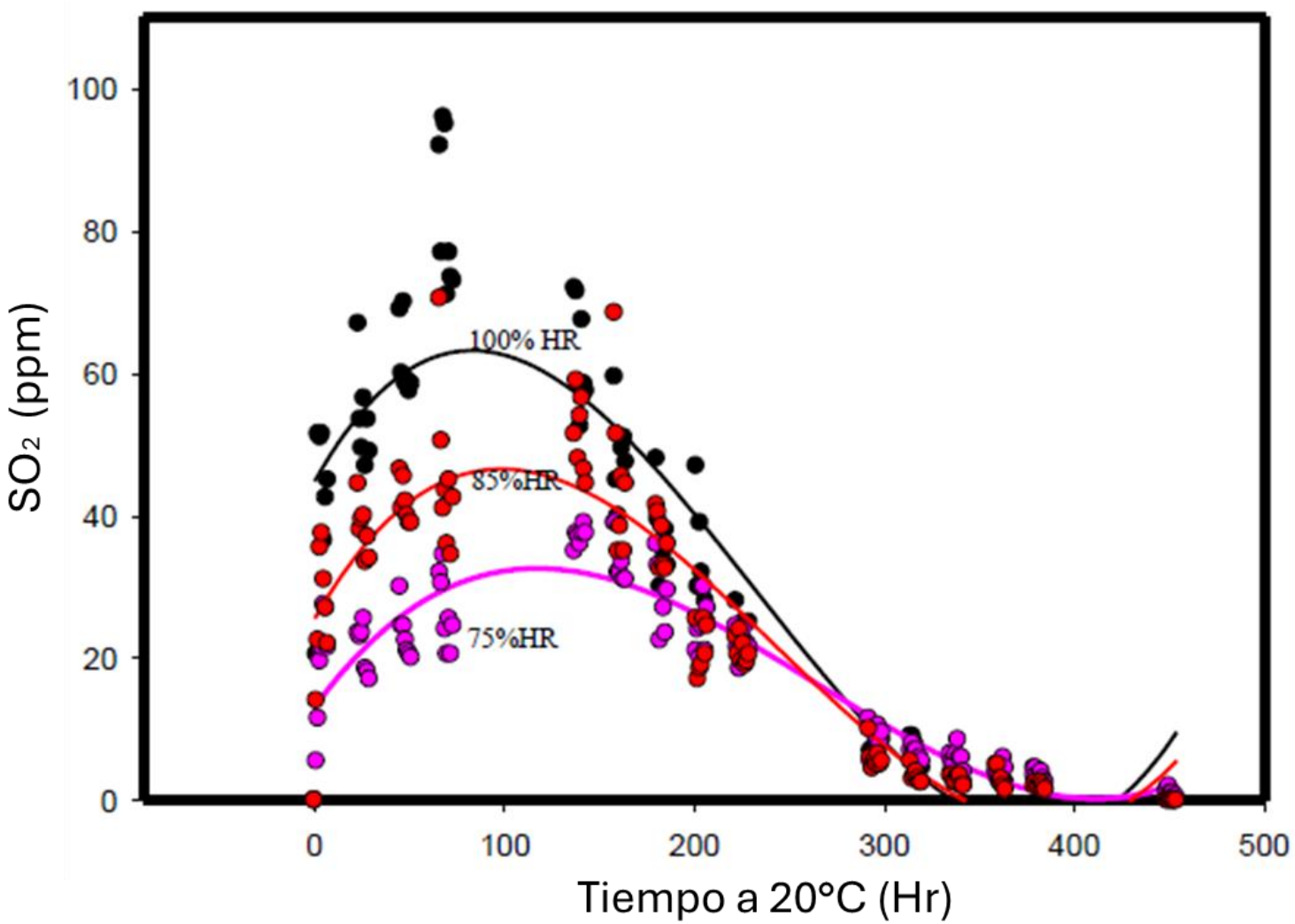
Influence of Relative Humidity on the Emission of SO_2 from Sulfur Dioxide pads



Fuente; J.P. Zoffoli

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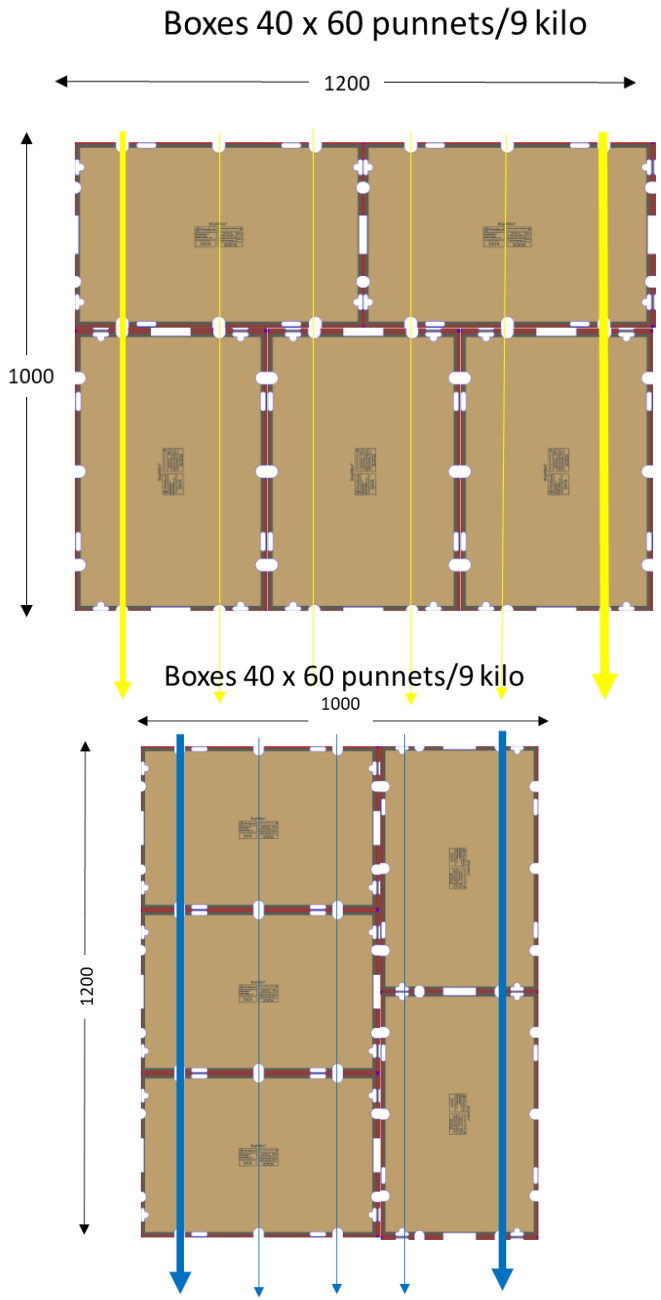

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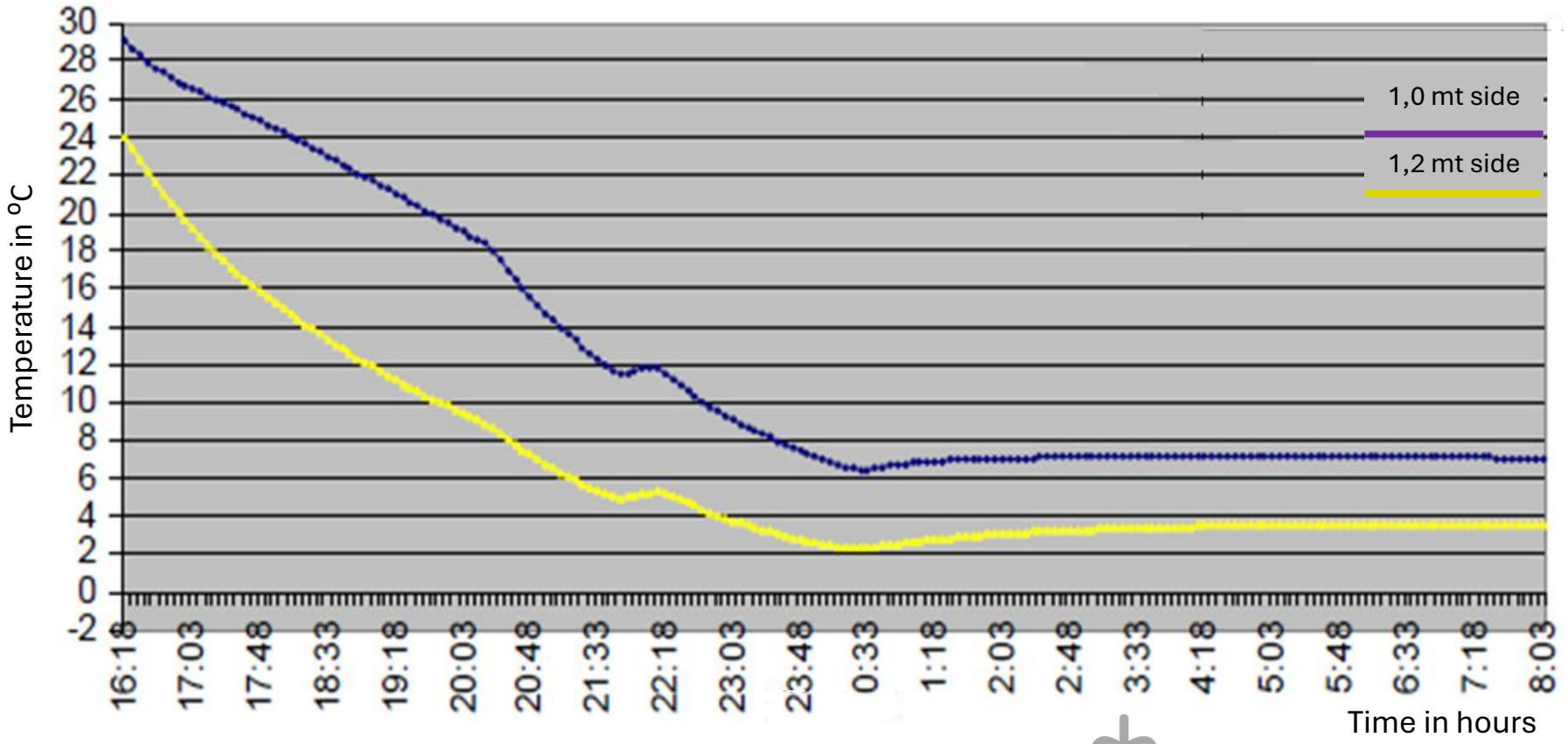
Comparison of pallet cooling on the 1-meter side versus the 1.2-



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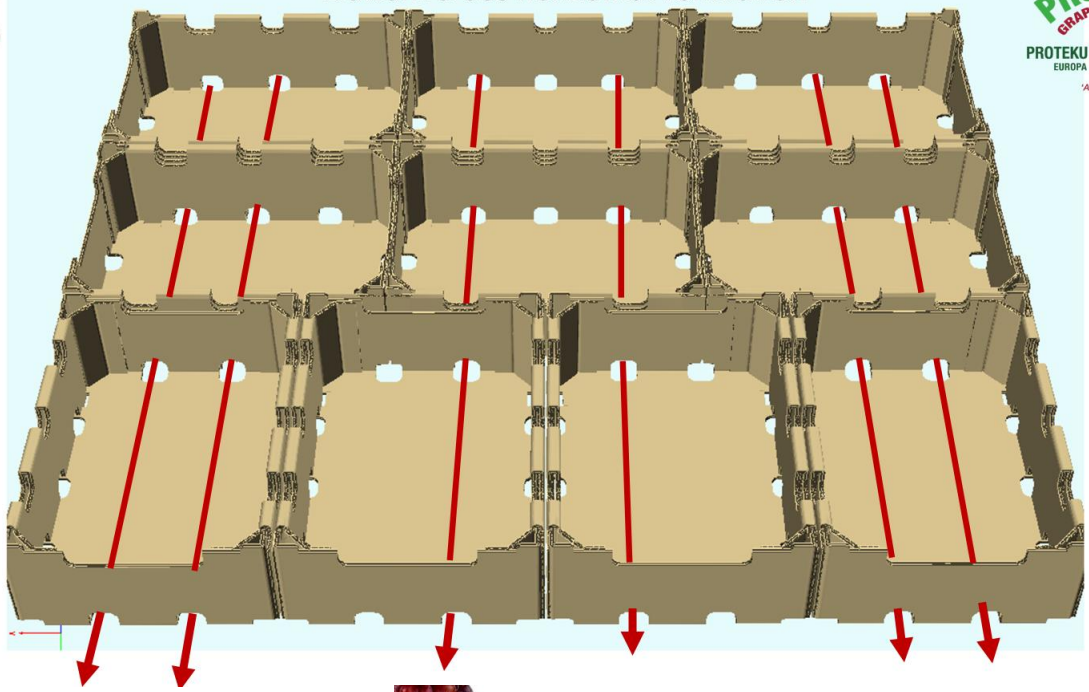
Source: PT&I Zoffoli 2008 BGMA Brazil, communication by R. Mercado EBFT 2010



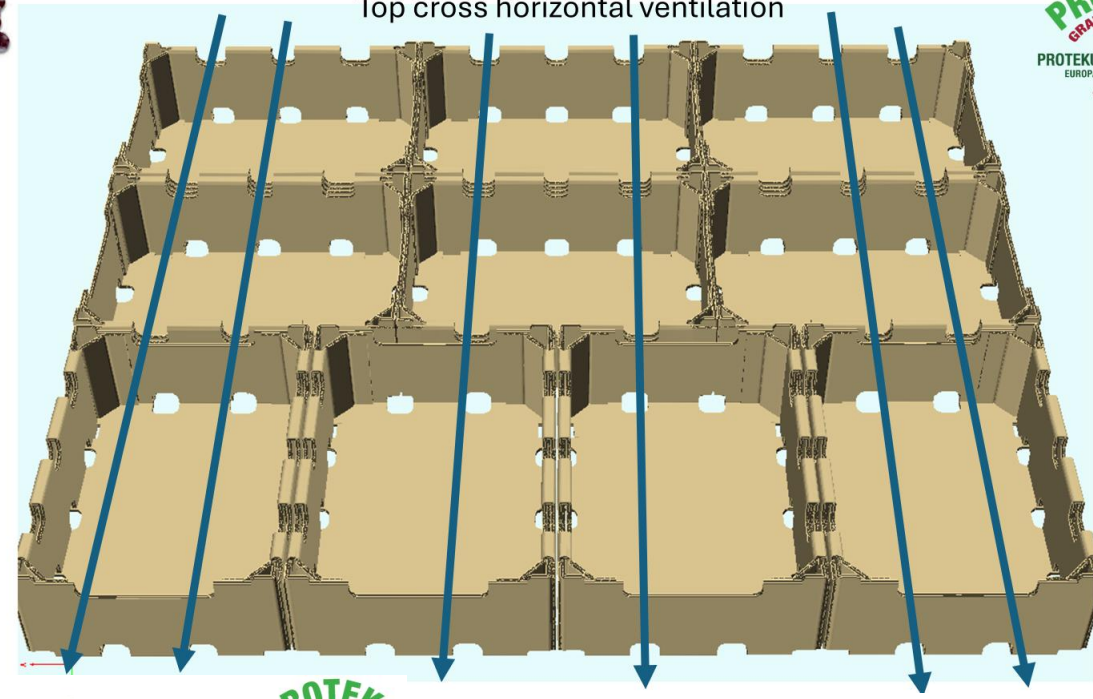


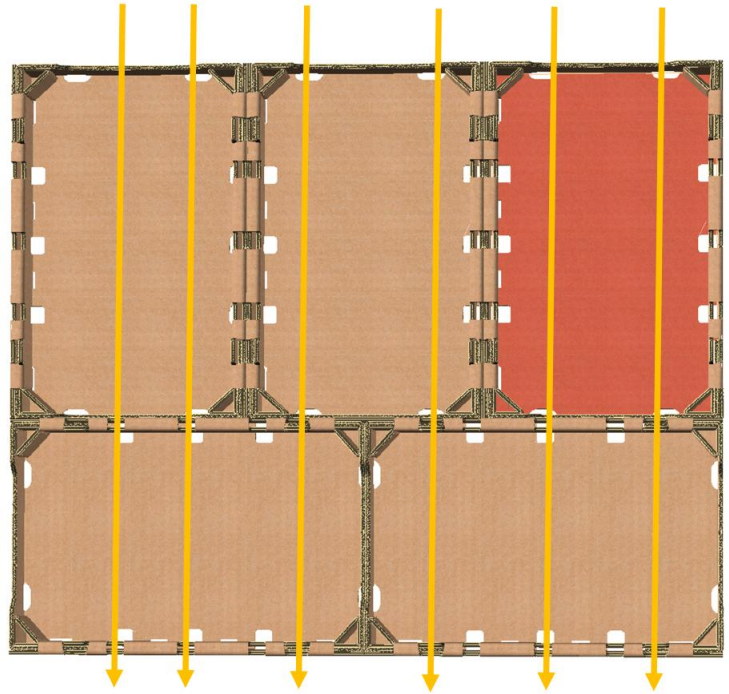
Source: pic share by C. Yañez 2025

Bottom cross horizontal ventilation



Top cross horizontal ventilation





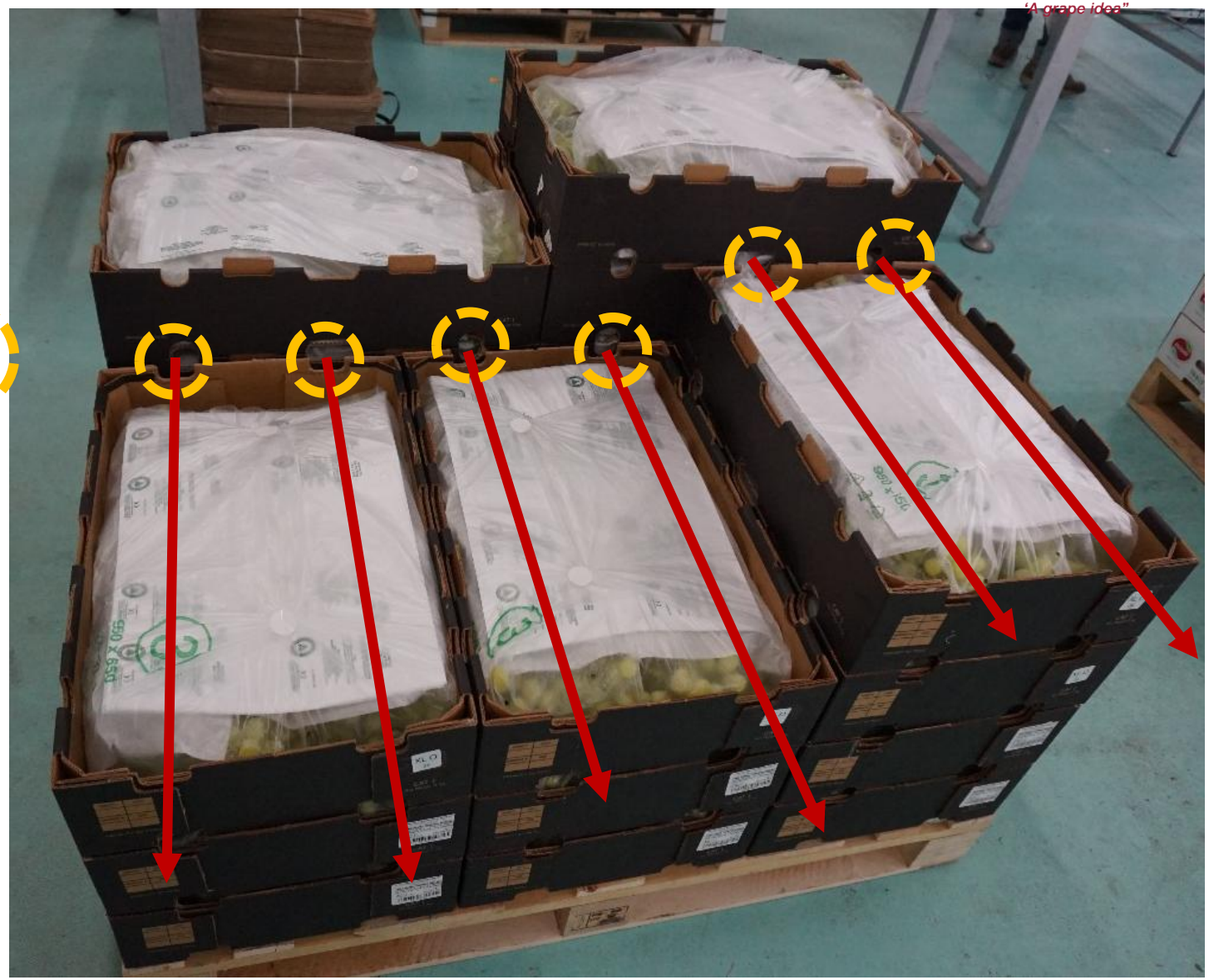
Open top 40 x 60 boxes with Good cross horizontal and vertical ventilation
Top and bottom peripheral cross ventilation horizontal and vertical



Open top 40 x 60 boxes with Good cross horizontal and vertical ventilation









Open top 40 x 60 boxes with
Good cross horizontal and vertical ventilation
Top and bottom peripheral cross ventilation horizontal and vertical, from the 1 m and 1,2 m as well




PRODUCE OF SOUTH AFRICA
PRODUCE OF SOUTH AFRICA
PRODUCE OF SOUTH AFRICA
90mm
90mm
PAP
FSC

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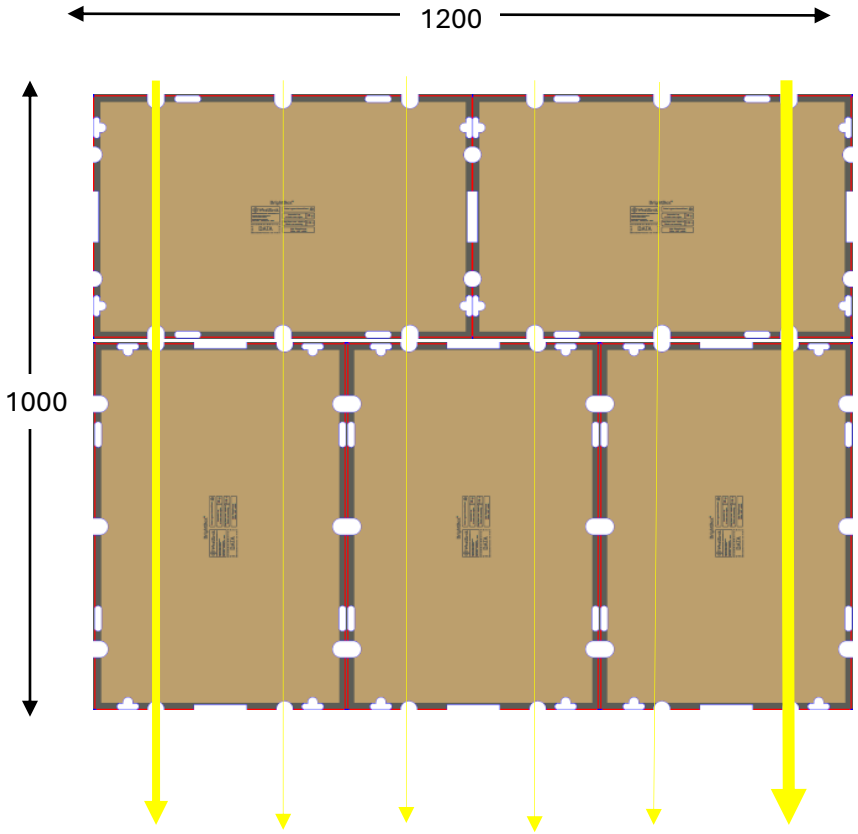
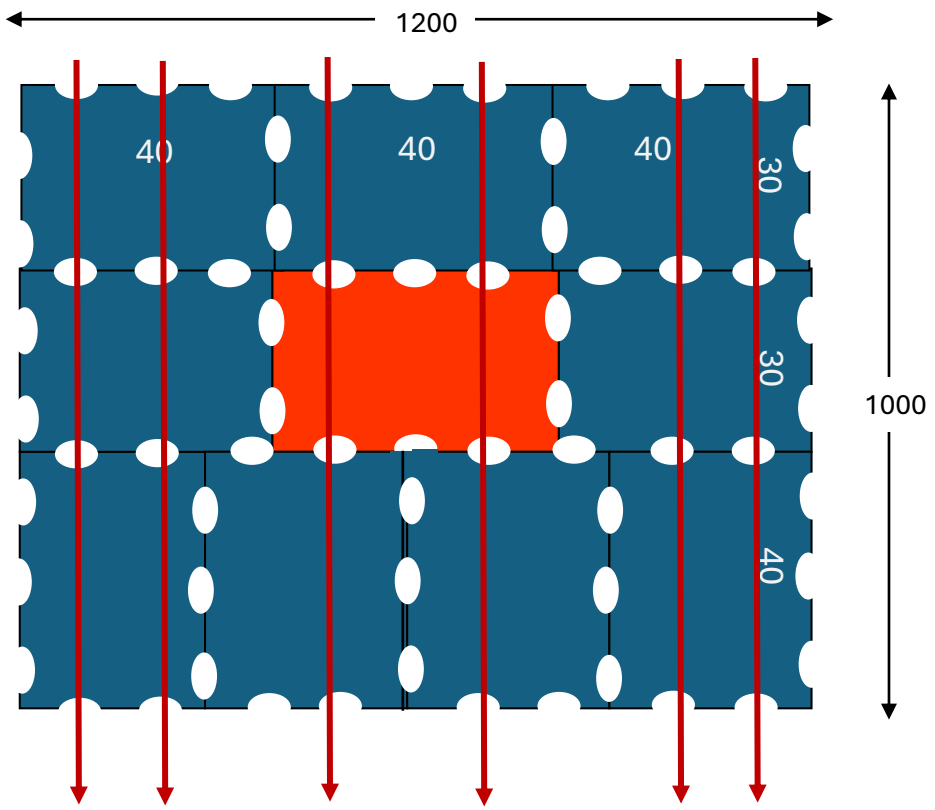
Air flow direction

Boxes 40 x 60 punnets/9 kilo



Air flow direction

4,5 kilo boxes



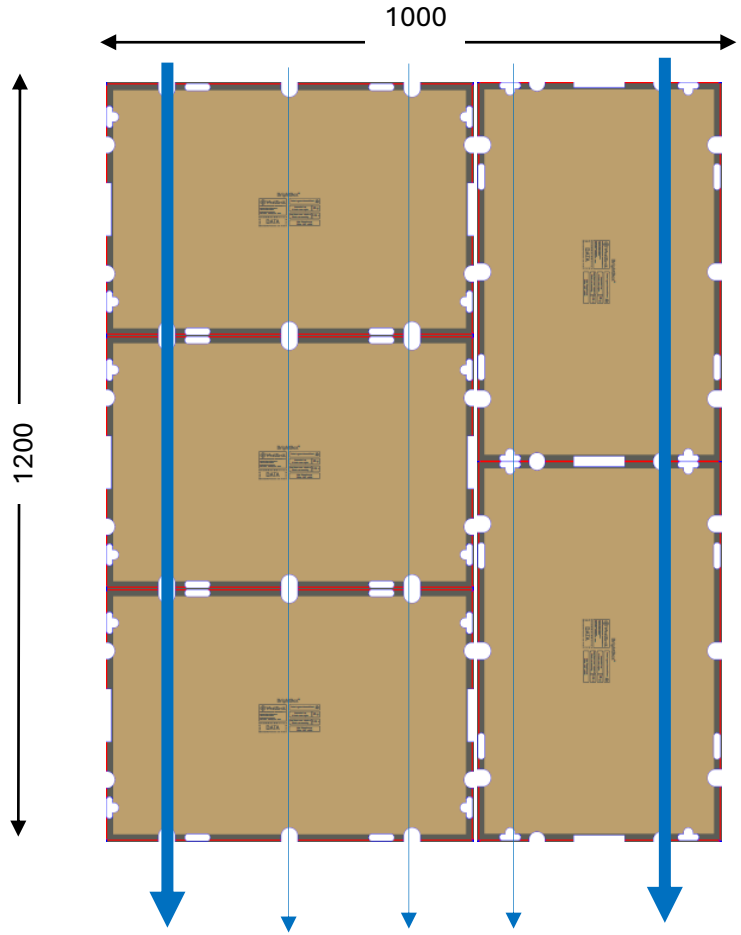
Aire force Cooling direction by the 1,2 mt right shortest distance for the air providing good box cross ventilation



Pallet base format

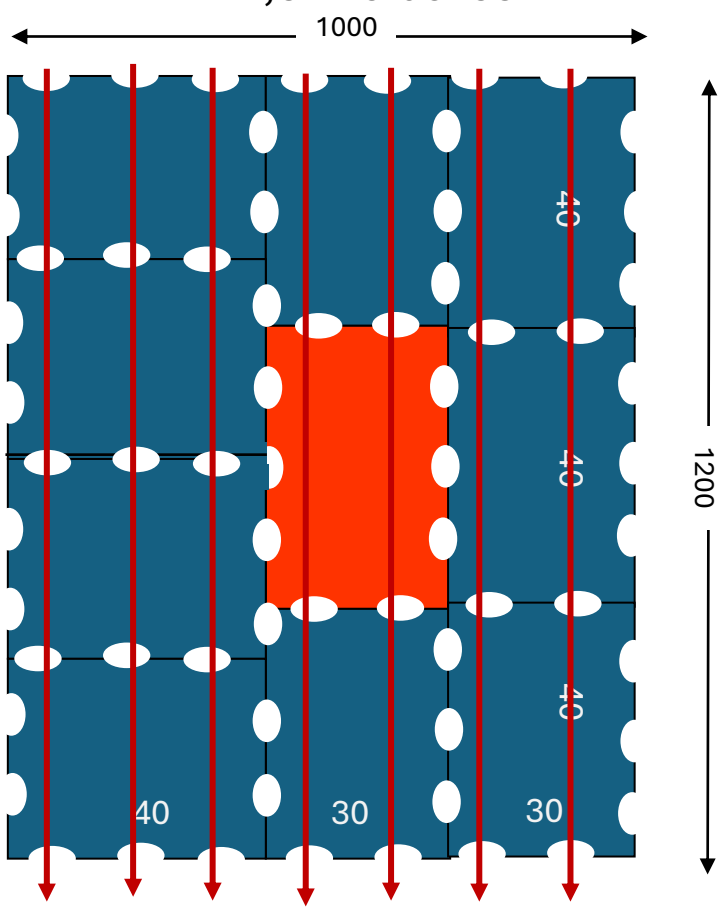
Air flow direction

Boxes 40 x 60 punnets/9 kilo



Air flow direction

4,5 kilo boxes



Air flow direction at the precooling through the 1.0 mt side, is the longest distance to the air to across the pallet (1.2mt), tend to have a longer pre-cooling time to reach the target temperature, however, choosing one side or the other, is basically the best cross ventilation across the pallet, that decision will prevail.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Convección


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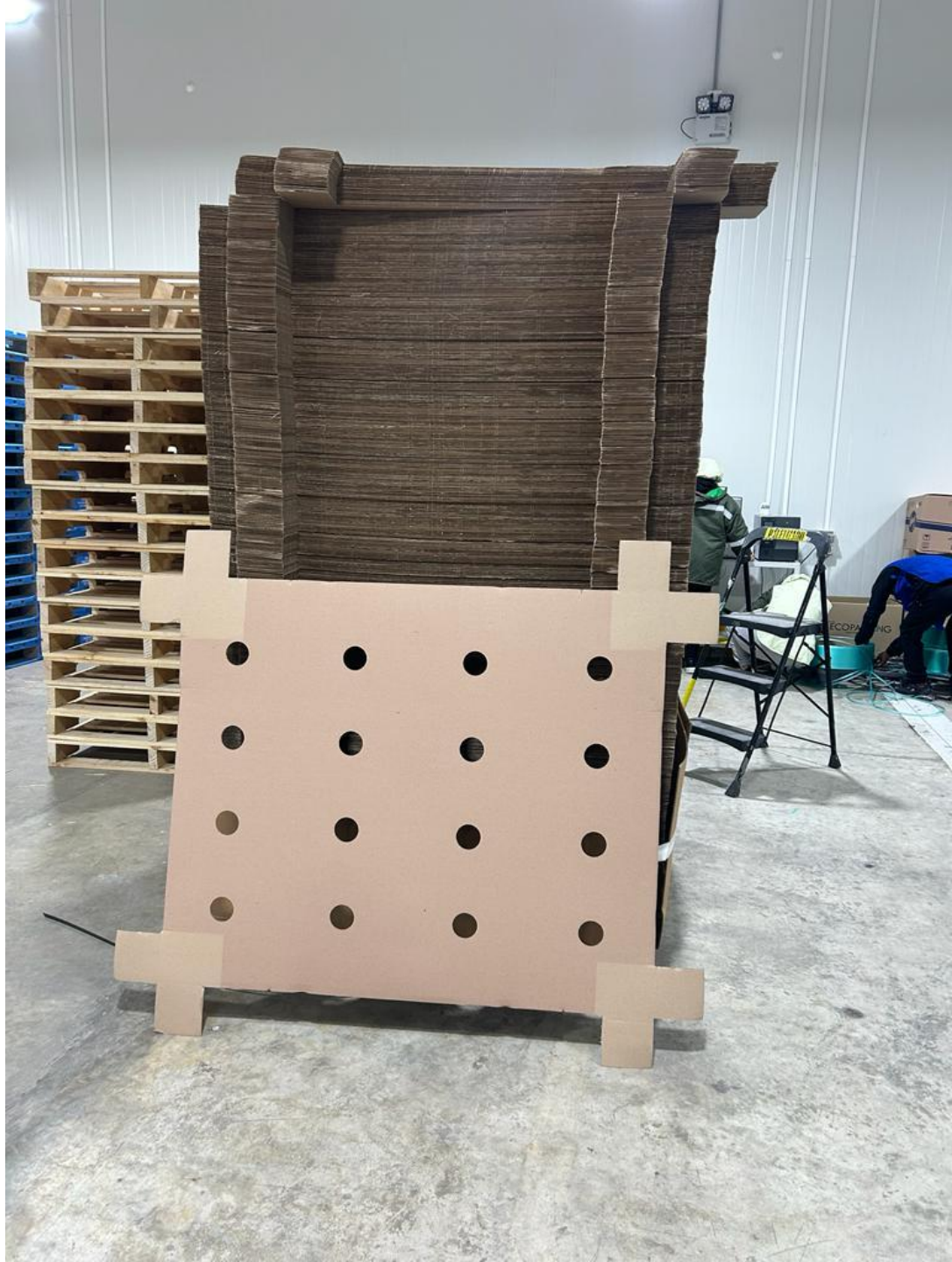



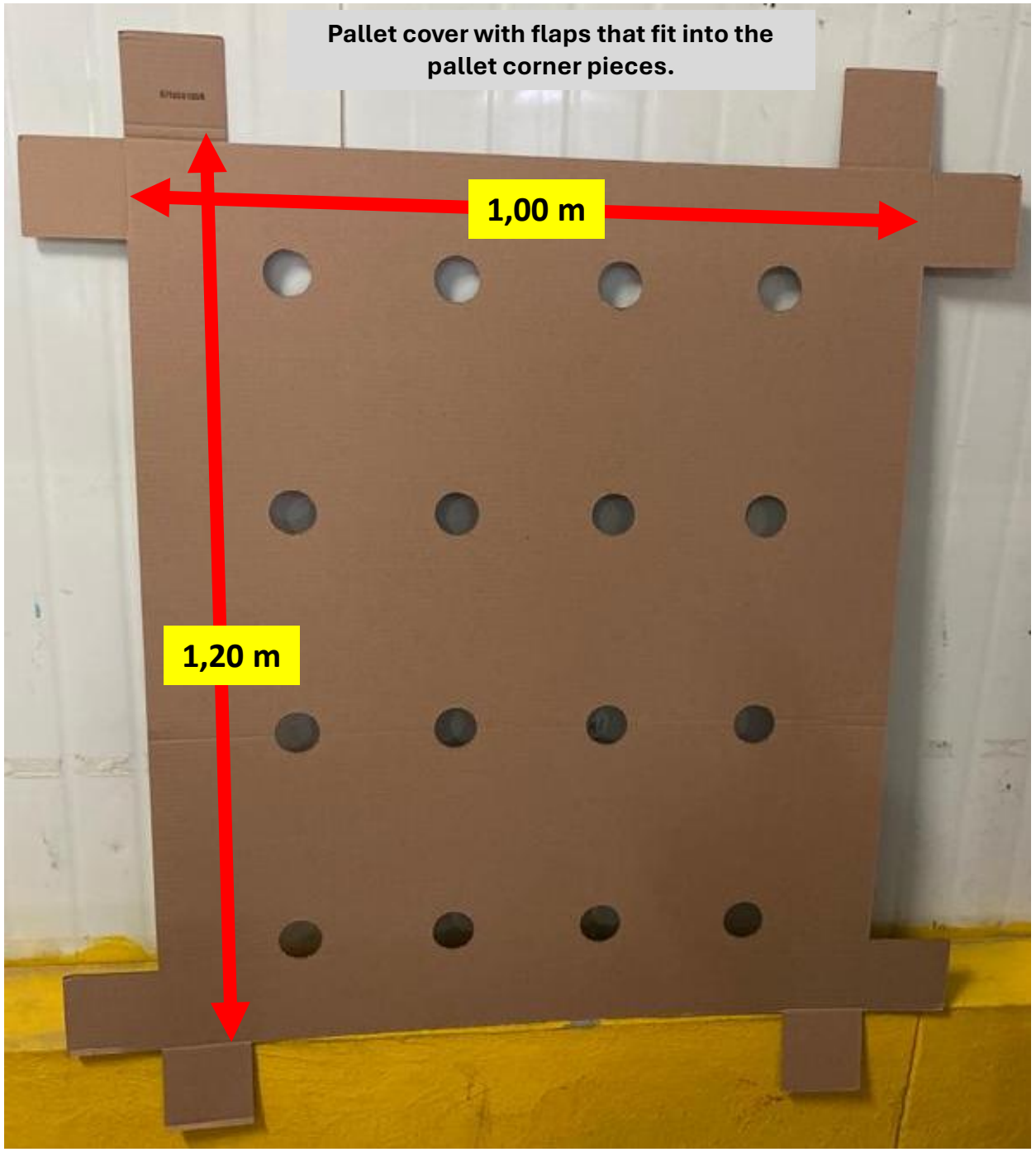

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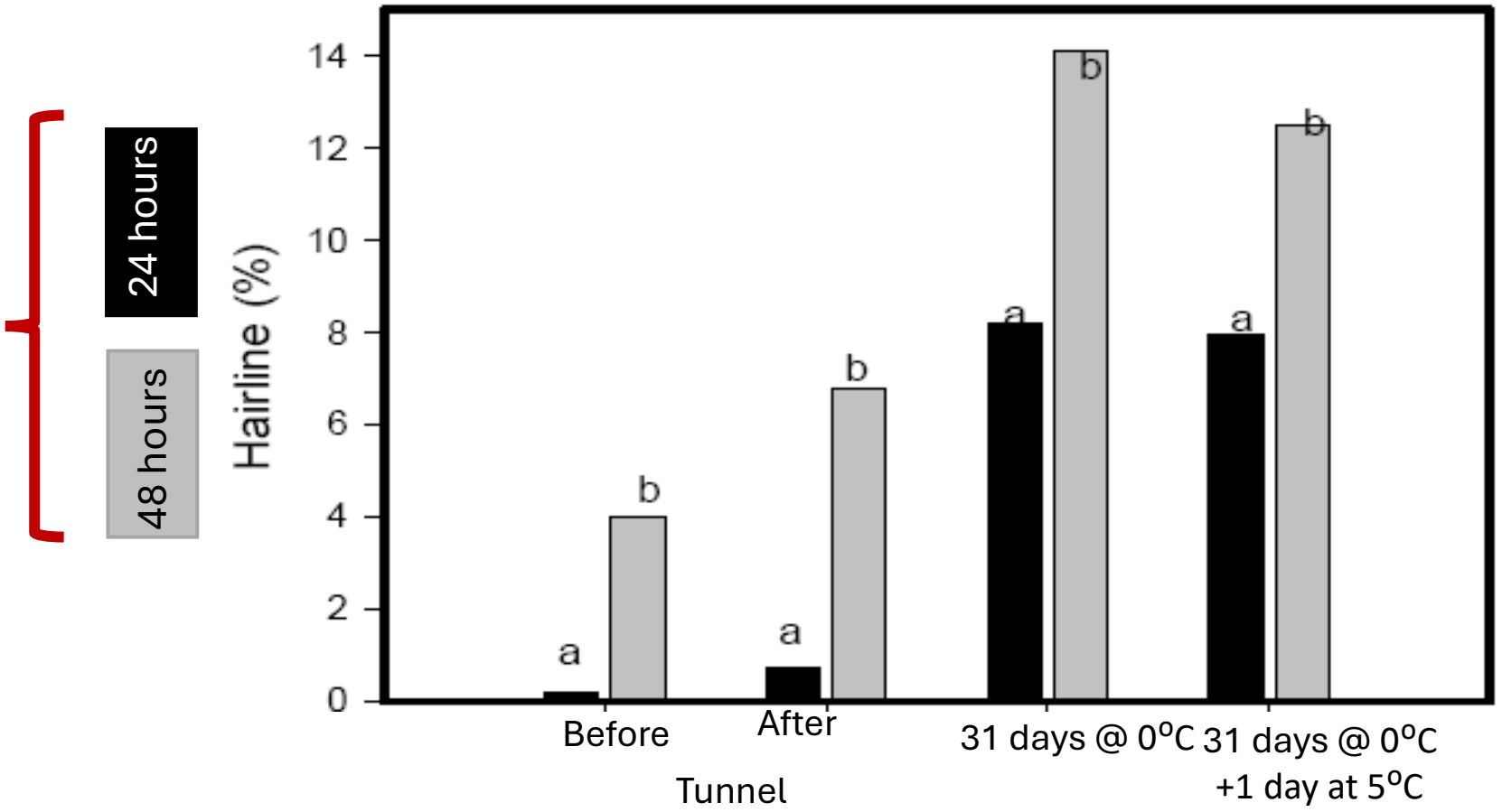
Hair Line

Hair line

It increases with the delay in the pre-cooling of the fruit due to condensation inside the box

Delay in entrance to the fast pre-cooling



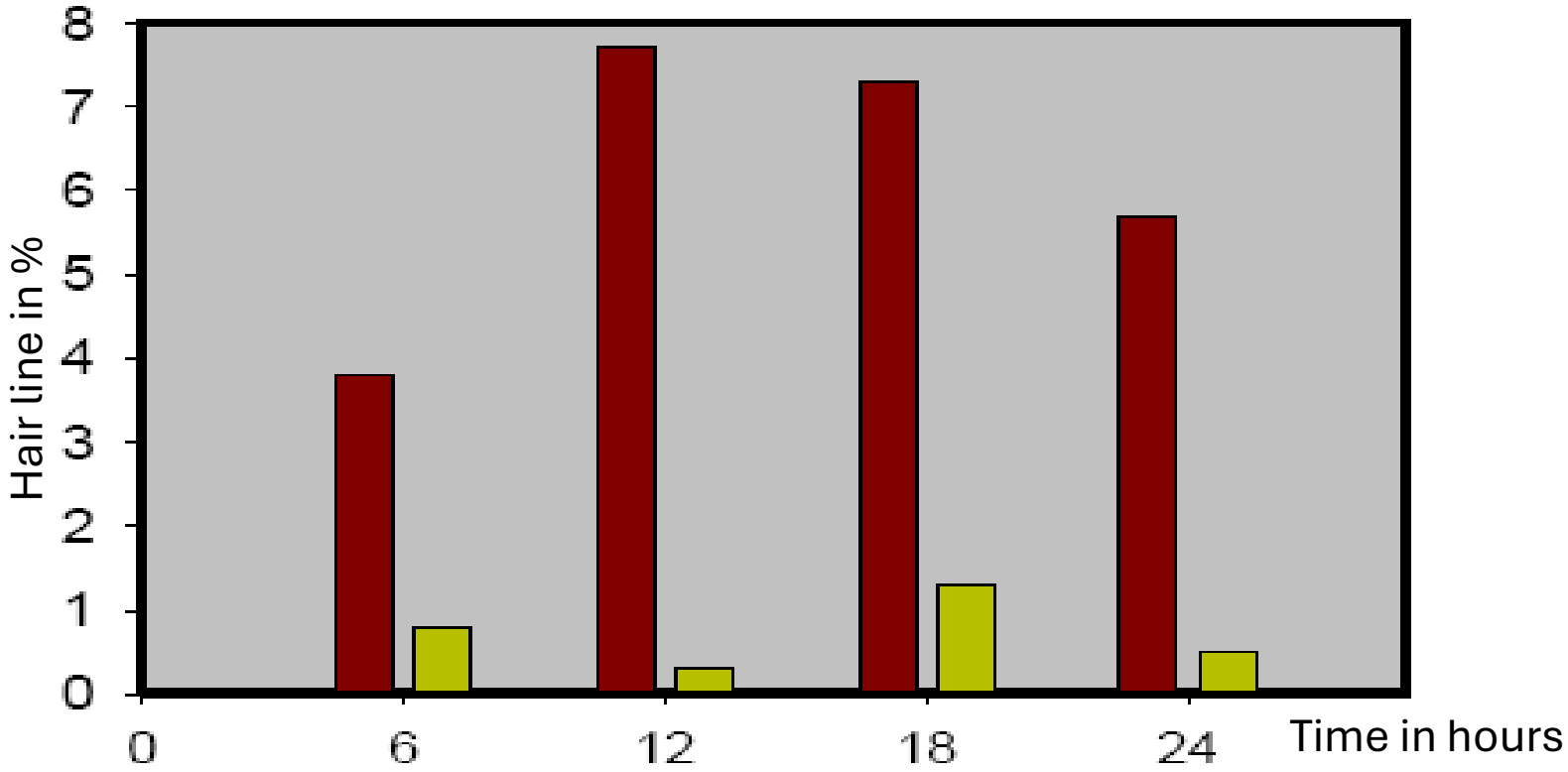
Source: J. P. Zoffoli 200-2001

Delay in cooling and effect on fine splitting or Hair Line

SO2 generators or SO2 Sheets are an essential tool for Botrytis control (maintained the greener stems or delay borrowing stems Salgado 2024), but proper management
wrong in the cold chain transform them into a deadly weapon for the condition of the fruit causing a series of post-harvest damages.

Packing with SO2 pad

Packing without SO2 pad



Source: J. P. Zoffoli 200-2001



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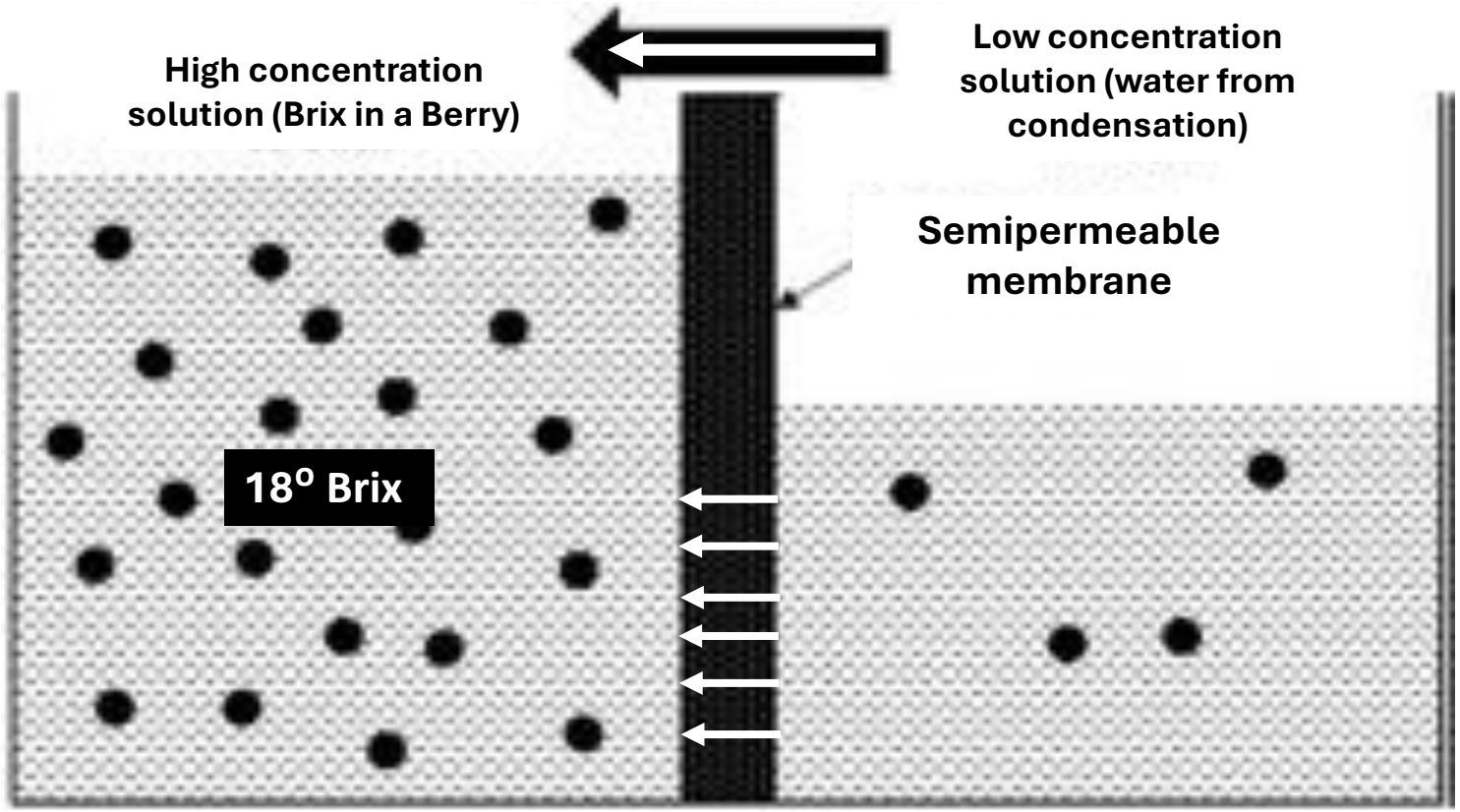
Water flow direction



Osmosis

Osmotic lysis

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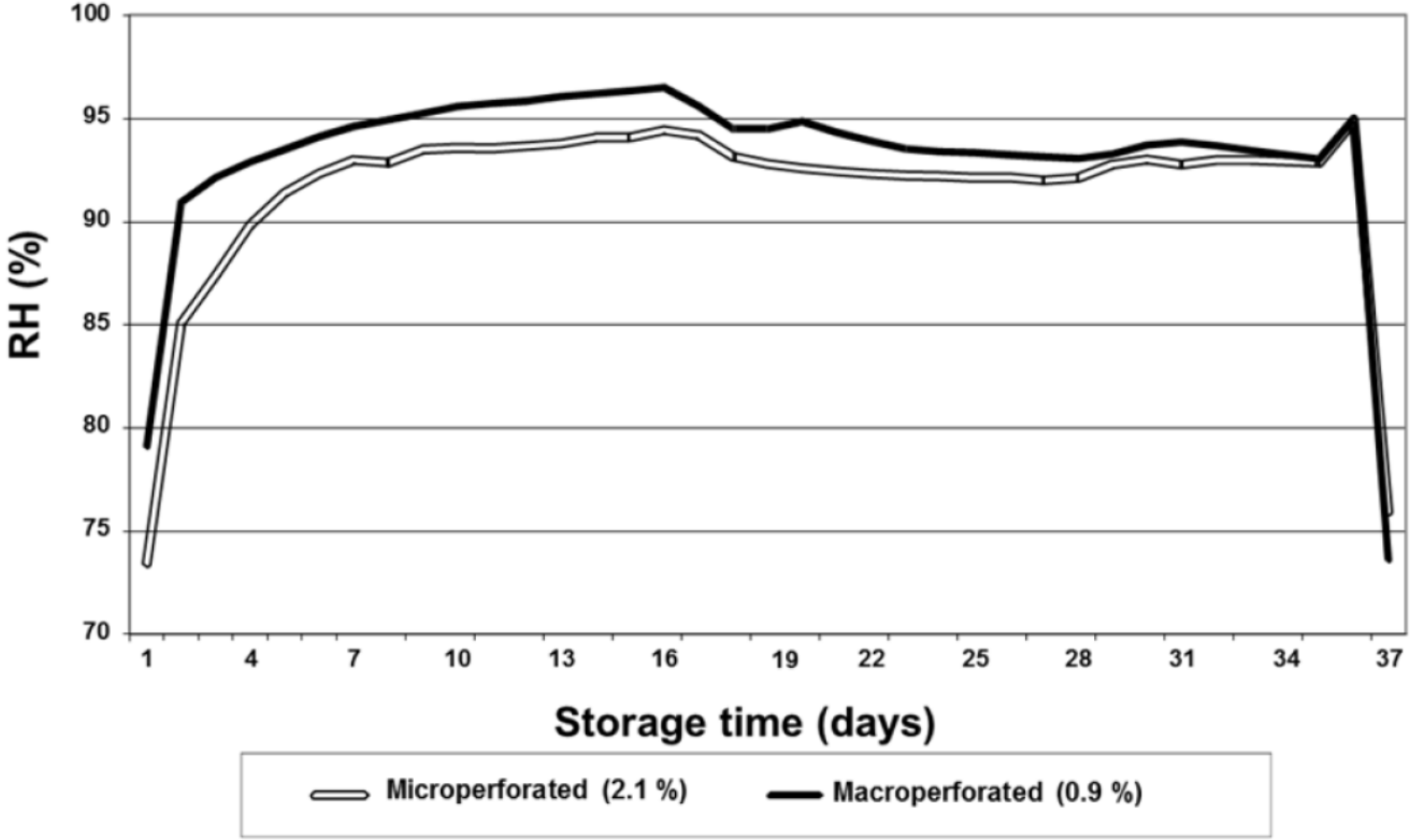
Ventilated area of the liner



- Greater ventilation reduces the relative humidity inside the box

- This impacts the activation threshold of SO_2 generators and helps maintain a stable environment for their performance.



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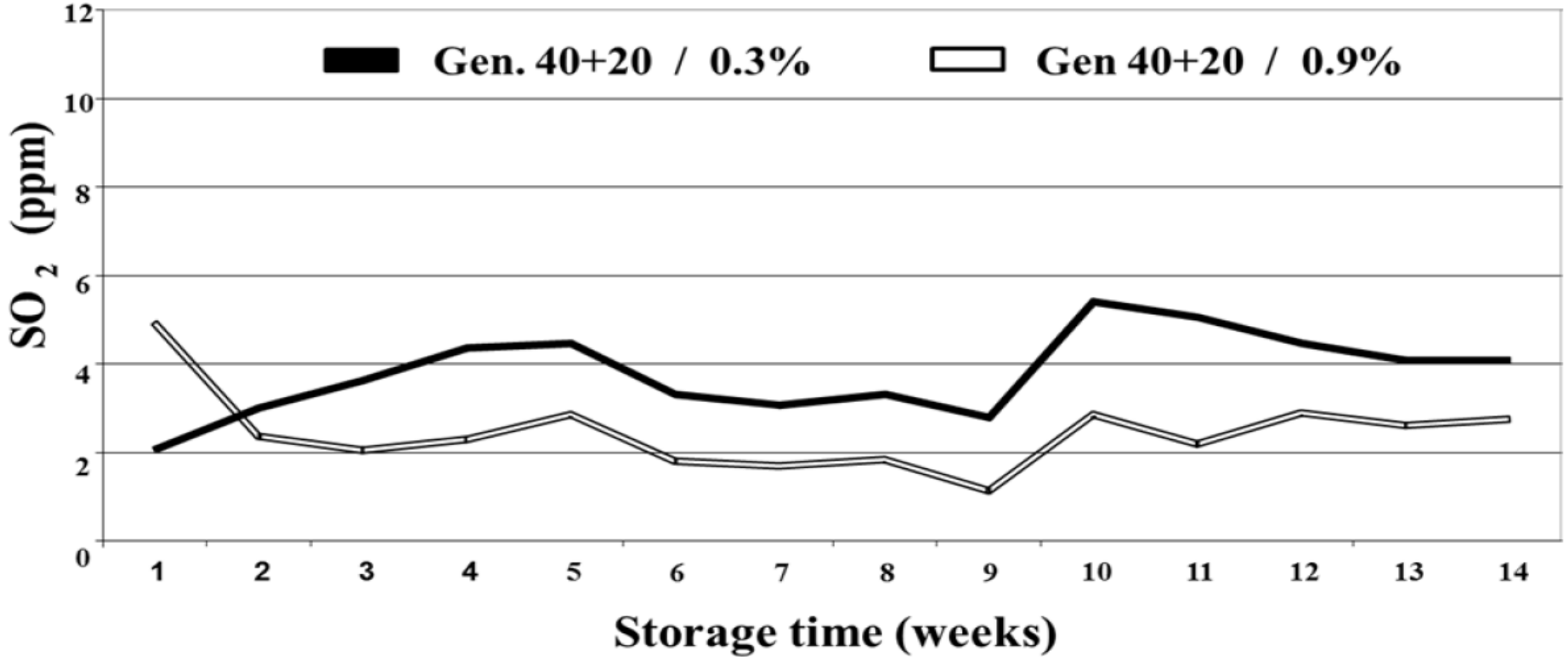
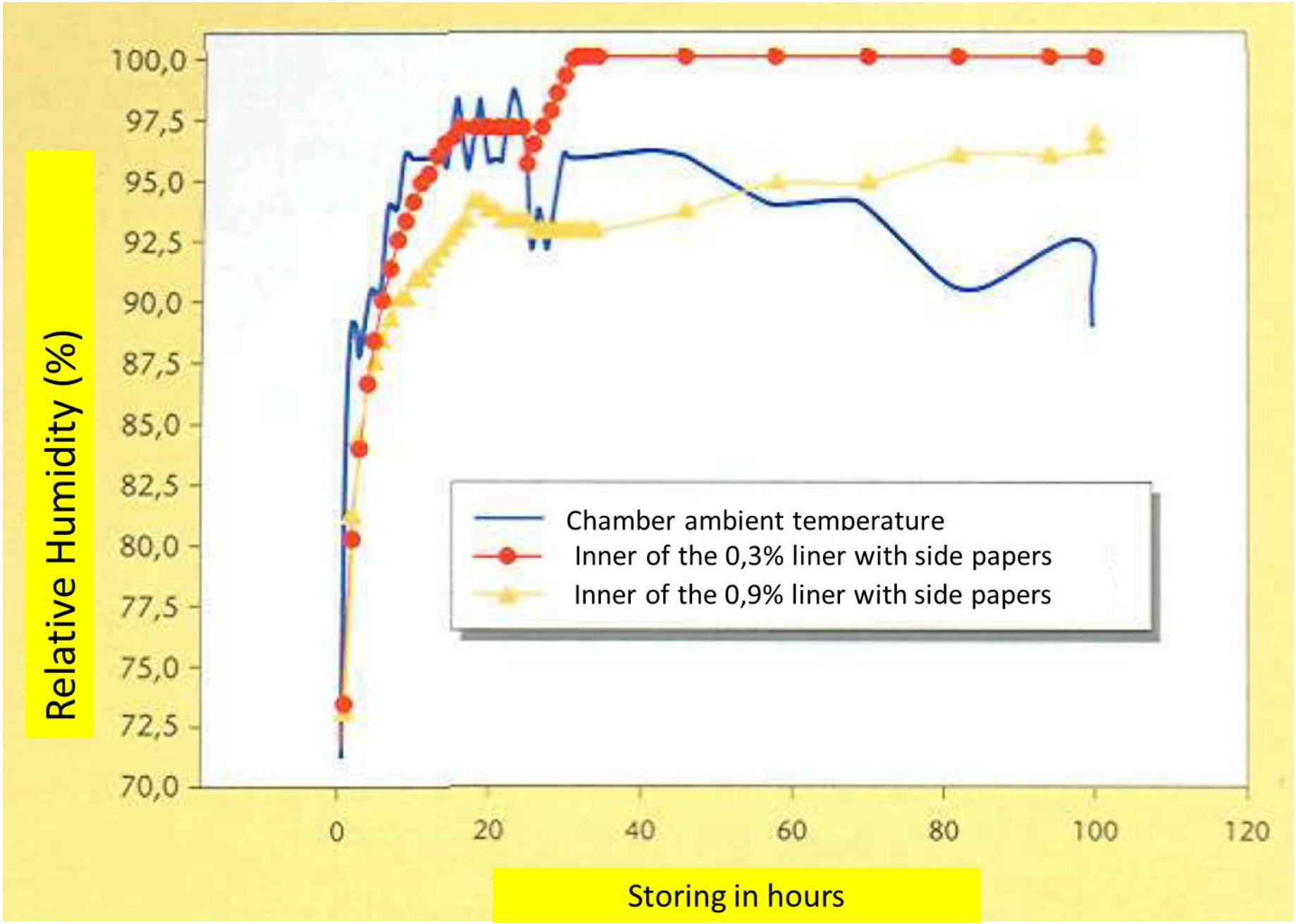
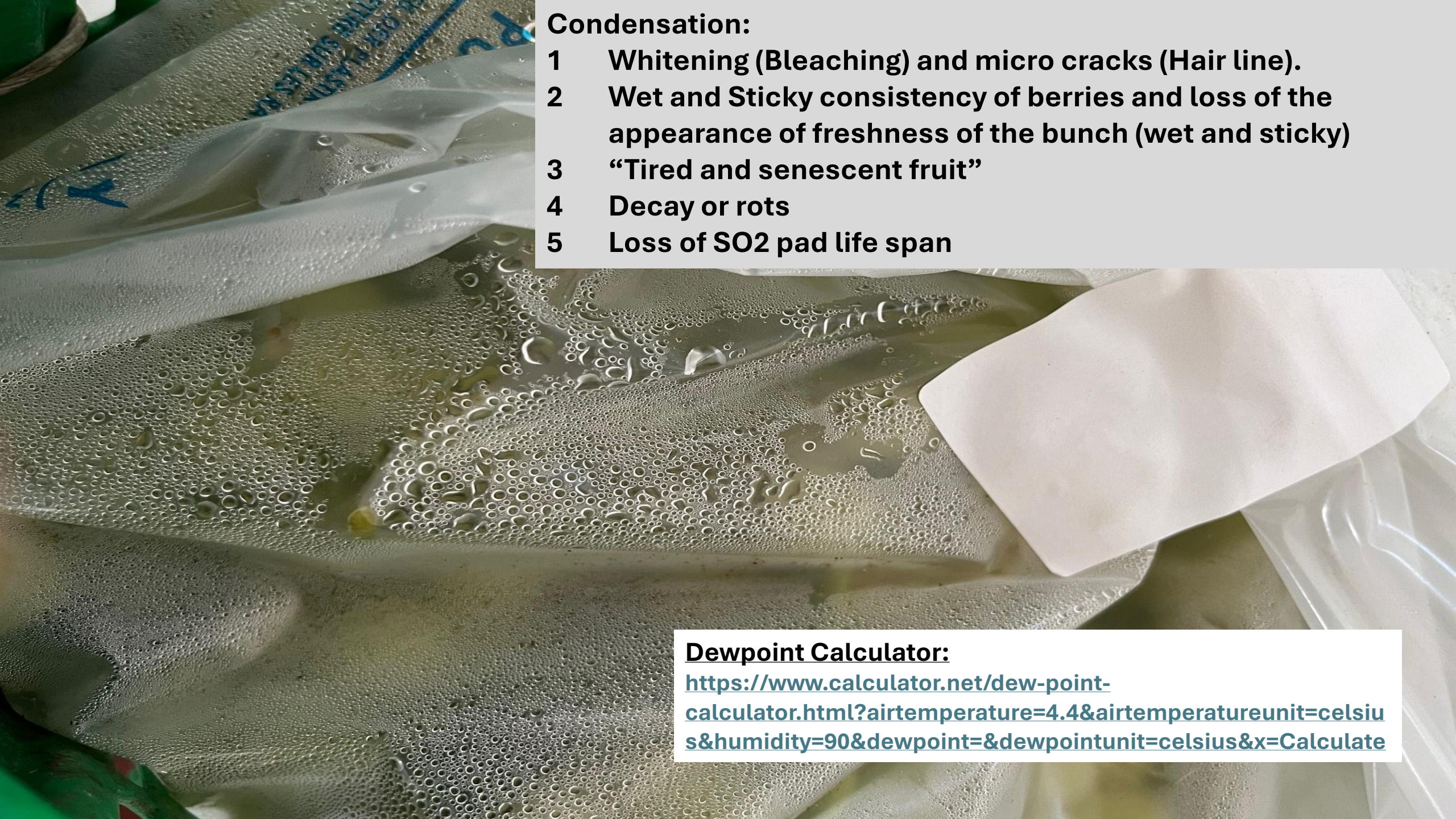
Ventilated area of the liner







Source. JP. Zoffolli Aconex edition 88



Condensation:

1. Whitening (Bleaching) and micro cracks (Hair line).
2. Wet and Sticky consistency of berries and loss of the appearance of freshness of the bunch (wet and sticky)
3. “Tired and senescent fruit”
4. Decay or rots
5. Loss of SO2 pad life span

Dewpoint Calculator:

https://www.calculator.net/dew-point-calculator.html?airtemperature=4.4&airtemperatureunit=celsius&humidity=90&dewpoint=&dewpointunit=celsius&x=Calculate

Bleaching



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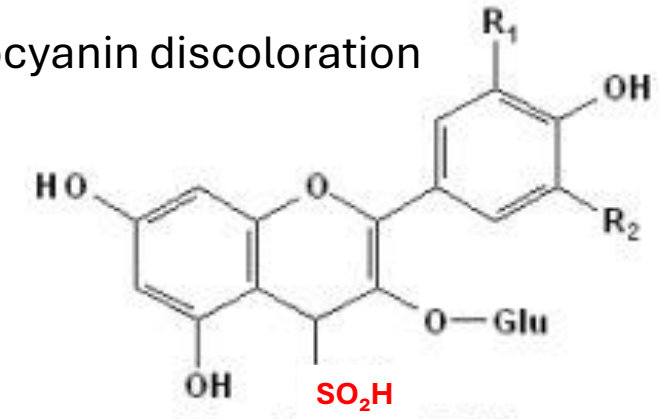
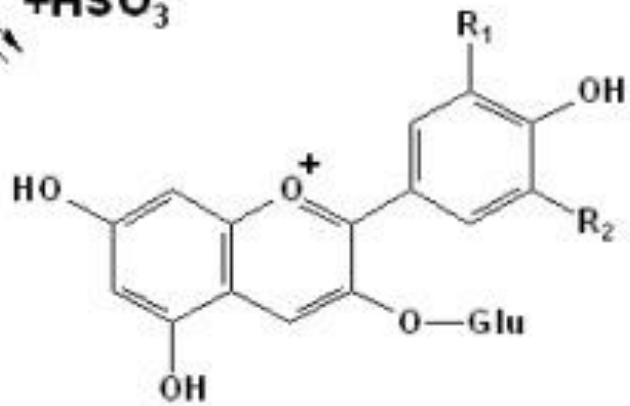
Anthocyanin discoloration

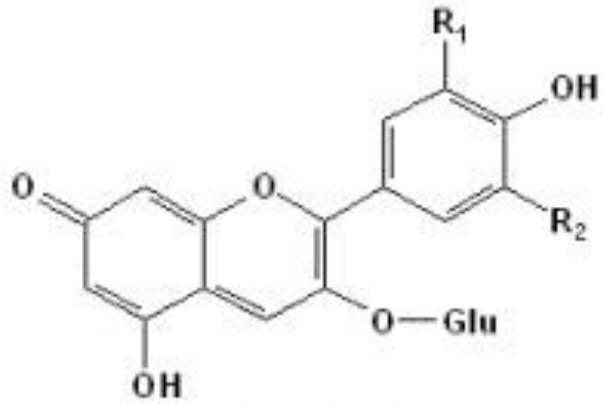


Bisulfite addition flavene compound (colorless)

$+HSO_3^-$ ⇌ $-H^+$



Flavylium cation (orage to purple)



Quinoidal base (blue violet)

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BLOCKBUSTER

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NOKIA
Connecting People

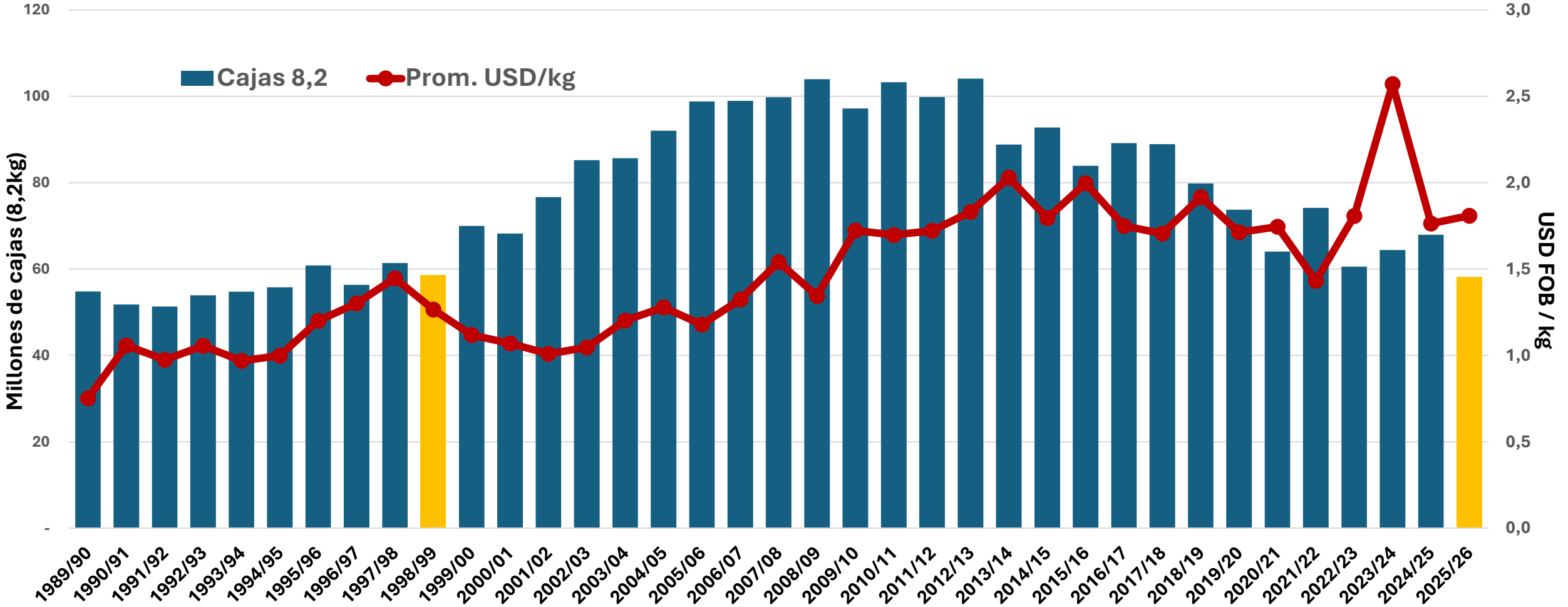
YAHOO!



Chilean Table Grape Exports (8.2 kg Cases)

Since season 1989 / 90

AgroFresh



Source: ODEPA 2026

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“Great enterprises are never the work of a single individual. They are the result of a committed team”



Steve Jobs (1955-2011)



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Thank You Have a *Grape* Day

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August 2026

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