SASEV/SATI 2020 Virtual Table & Dried Grapes Information Days

How can we avoid…reduce water loss and rachis browning?

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Despite the rachis is not the edible part of the cluster…it is actually the key **"freshness indicator"**

CHALLENGES WE ARE FACING FOR MAINTAINING RACHIS QUALITY

WISHING LIST FOR CONSUMER?

APPEARANCE

Color

w/o decay

Berry size

Rachis

TEXTURE

Firmness

Juiceness

Crunchiness

FLAVOR

Sweetness (Total soluble solids)

Acidity (Titratable acidity)

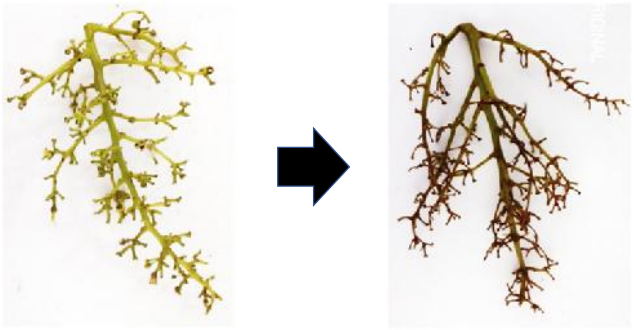
Aroma

SEEDLESSNESS

OVERALL QUALITY

CHALLENGE 1

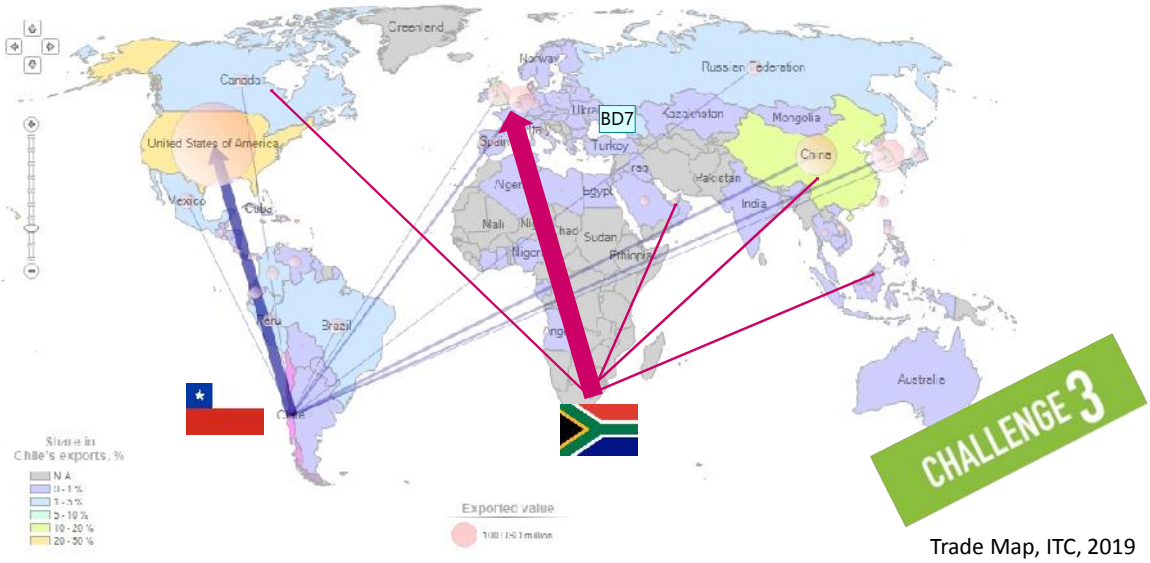
…some of them changes during postharvest



- ✓**TSS** keeps steady.
- ✓**TA** may decrease.
- ✓**Berry texture** could change.
- ✓**Berry damage** and **decay** usually increase.
- ✓**Water loss** increases in berry and especially rachis.

CHALLENGE 2

The “table grape route” for export countries



CHALLENGE 3

Trade Map, ITC, 2019

Diapositiva 6

BD7 Bruno Defilippi; 05/08/2020

A massive availability of new genotypes….Chile as an example

2010/2011 (5,000 T)	2018/2019 (70,000 T)
Ralli Others	Timpco Sweet Celebration Allison Ralli Krissy

2010/2011 (<5,000 T)	2018/2019 (23,000 T)
Prime Others	Arra 15 Blanc Seedless Timpson Prime Others

2010/2011 (2,000 T)	2018/2019 (15,000 T)
Midnight Beauty	Sable Seedless Maylen Midnight Beauty Sweet Favors Others

CHALLENGE 4

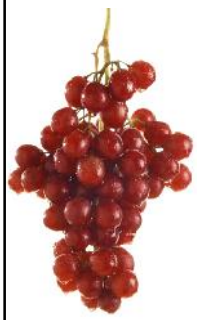
Source: Adapted from IQonsulting

And many other challenges…

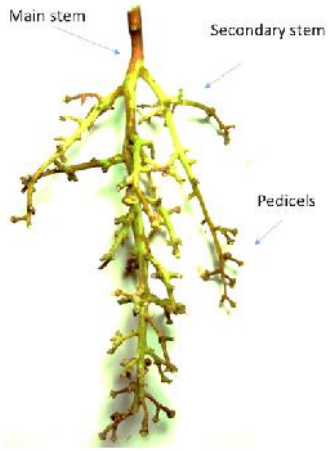
- ✓ Lack of ***knowledge*** about rachis physiology.
- ✓ Harvest time mainly based only on ***sugar (TSS)*** content.
- ✓ Inadequate ***harvest & postharvest practices*** (Temperature/RH).
- ✓ ***Environmental*** phenomena (heat stress and water deficit)
- ✓ Little availability of ***technologies*** for extending rachis quality.

BASES OF RACHIS DETERIORATION

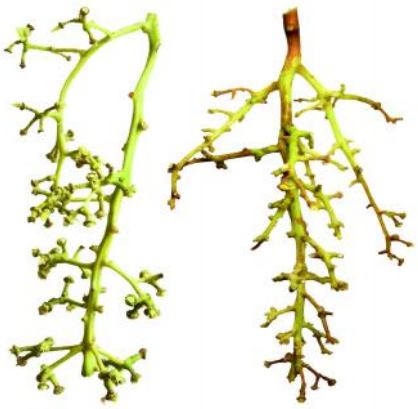
Rachis contributes a 3-8% of cluster´s total fresh weight



- ✓ Respiration rate is **10-50 time higher** than berry.
- ✓ A very high area:volumen ratio.
- ✓ Important amount of stomata and lenticels.
- ✓ Small amount of wax in cuticule…almost absent.



I. Cluster water loss



✓ **What is it?**.

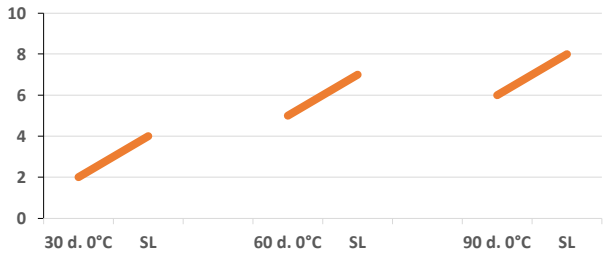
Cumulative process of water loss from the berry and rachis.

✓ **Visual symptoms?**.

- Dehydration
- w/ or w/o rachis browning

✓ **More susceptible structure?.** Vegetative tissues w/o waxy protection, i.e. the rachis.

Bunch water loss (%)



What are the thresholds of cluster water loss for getting damage?

>2% = a negative effect on **rachis**

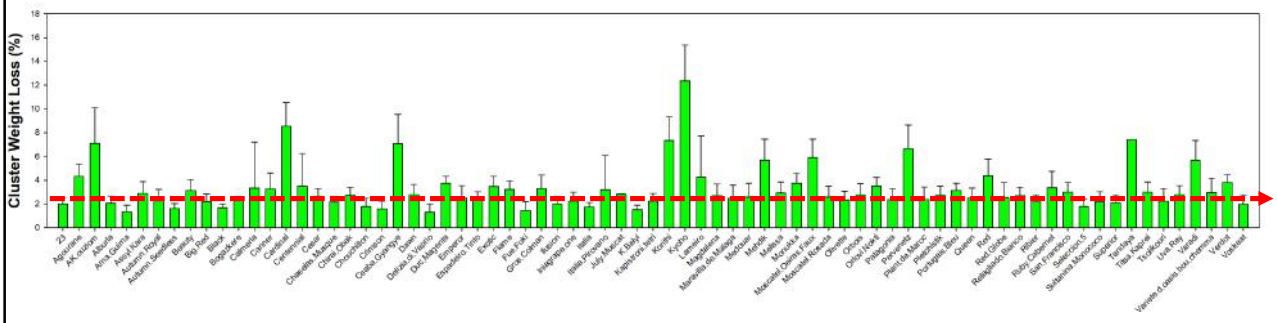
2-4%= a negative effect in **berry texture**

> 5% = probably berry with water loss symptoms

(Crisosto et al., 2001; Lichter et al., 2011)

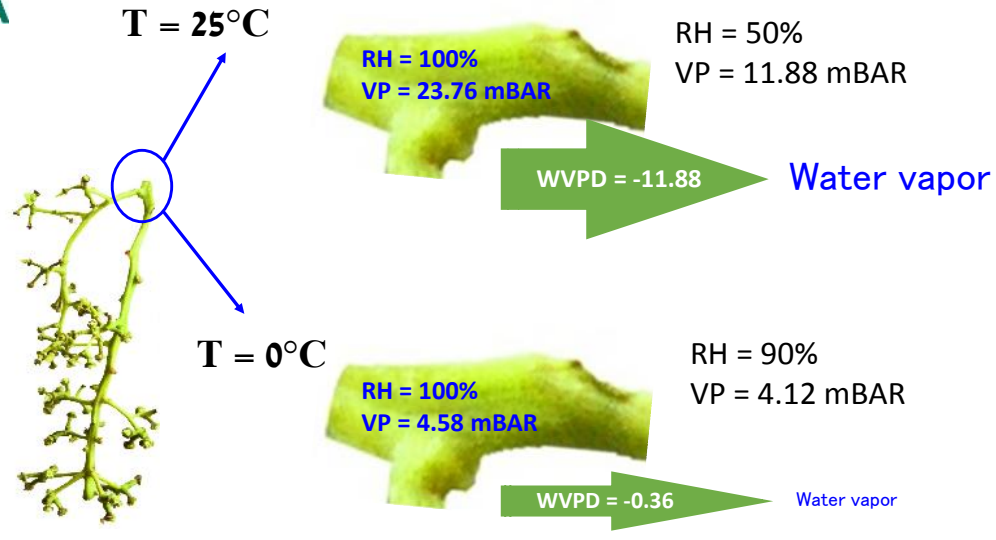
Cluster water loss for 78 grape varieties

(After 30 d. at 0°C. Season 2018/19)



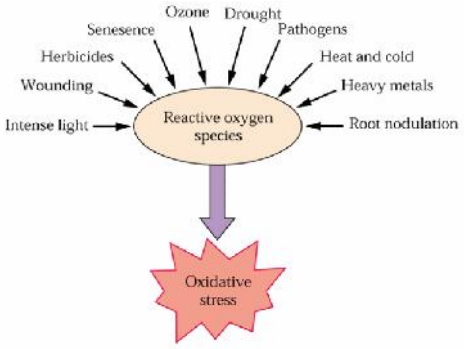
FONDECYT 11161044; CORFO 09PMG-7229

Effect of temperature on WVPD and rachis transpiration



II. Tissue browning

- ✓ A senescence regulated process.
- ✓ Tissue browning as the main symptom (PPO, PAL, others)
- ✓ Involves oxidative stress metabolism.



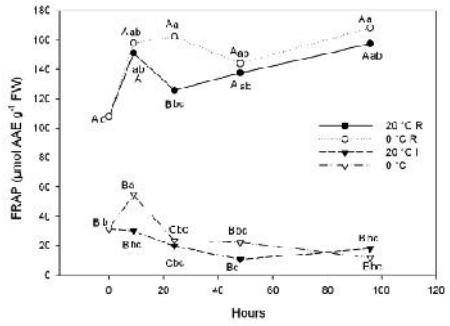


Figure 2. Determination of the total antioxidant capacity (FRAP) in rachises of mature clusters (R, circles) and fully elongated inflorescences (I, triangles) of Red Globe table grapes stored for 0, 9, 24, 48 and 96 h at 0 and 20 °C. Different lower case and capital letters indicate significant differences ($P \leq 0.05$) based on Tukey's comparison test using samples of the same tissue type (R or I) or from the same sampling time point, respectively. FW, fresh weight; AAE, ascorbic acid equivalent.

(Campos-Vargas et al. 2012)

GENOTYPE

High Heredability

- Berry Size
- Seedlesness

Low heredanility

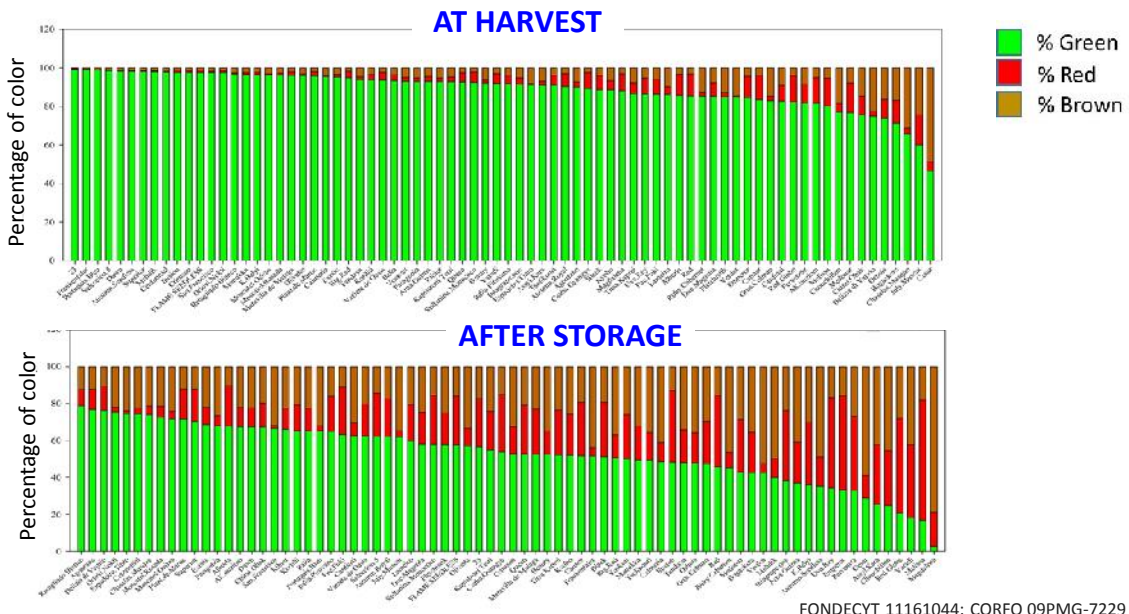
- Rachis vigor
- Taste

Phenotype= Genotype + Environment

Rachis quality
Shattering
Berry firmness
Berry size

Climate
Cultural managements
Maturity stage at harvest
Postharvest handling

Rachis color profile for 78 grape varieties



FONDECYT 11161044; CORFO 09PMG-7229

MATURITY AT HARVEST

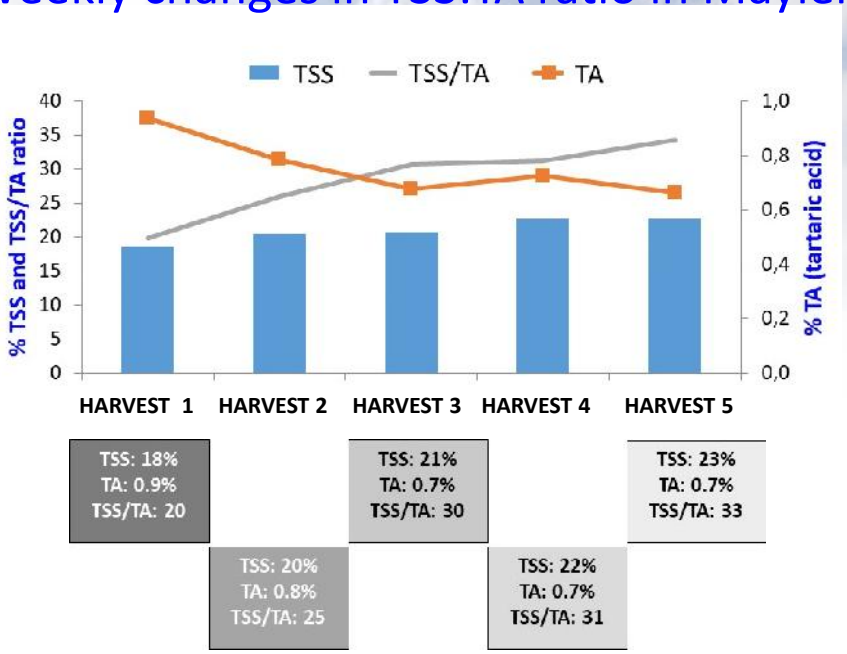
Main questions:

- ✓ Maturity stage at harvest?
- ✓ Harvest window?
- ✓ Harvest index?
- ✓ Storage potential?

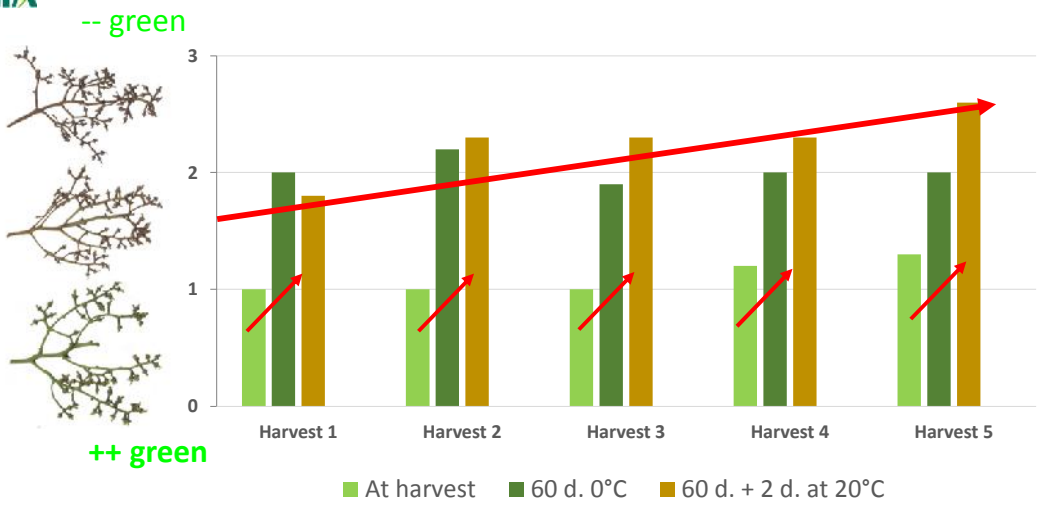
CORFO 09PMG-7229

Example:	**Selection 5.56 (known as Maylen)**
Berry color:	Black
Characteristics:	High titratable acidity

Weekly changes in TSS:TA ratio in Maylen



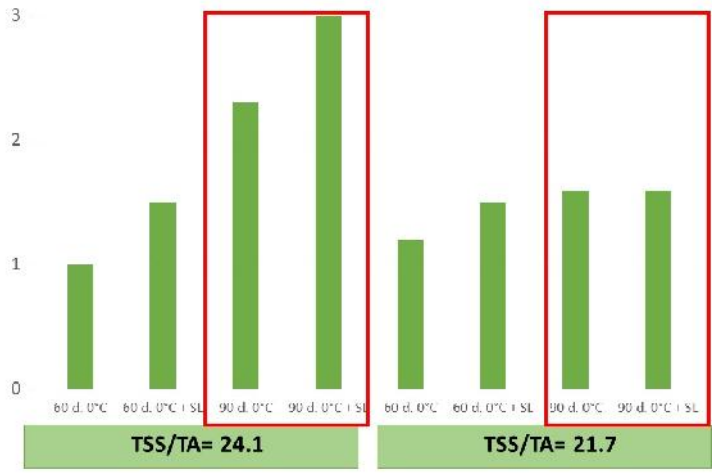
1. Rachis appearance



But with longer term storage….

-- green

++ green



Take home message: Maturity and storage period

POSTHARVEST MANAGEMENT AND HANDLING

Knowledge is there for a while….

- **Harvest time**
- **Temperature**
- **Cooling process**
- **Logistic (time between harvest and cooling)**

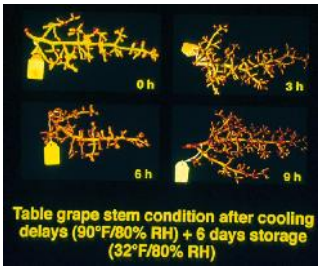
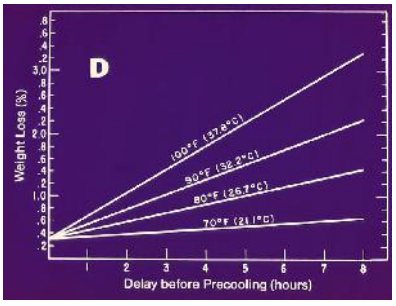


Table grape stem condition after cooling delays (90°F/80% RH) + 6 days storage (32°F/80% RH)

GRAPE

LOCATION	HANDLING PROCEDURE TYPICAL	EXPEDITED
	WT LOSS - %	
FIELD	3.00	0.50
COOLER	1.25	1.00
STORAGE	1.25	0.25
TRANSIT	1.50	0.60
TOTAL	7.00	2.35

Postharvest Technology Center, UCDavis…From the ´60s



Do the right thing and at the right time…

…and in the right way!!

Postharvest Technology Center, UCDavis…From the ´60s

PLANT GROWTH REGULATORS

External signals

Light
Quality
Quantity
Length

Mechanical Variables
Wind

Relative humidity

Temperature

Nutrition

Water

Pathogens

Gravity

CO_2

Internal signals

Hormones
CKs
Ethylene
GAs
Auxins
ABA
Brassinosteroids

Mechanical related to growth

Defense
Jasmonic acid
Salicylic acid

Development

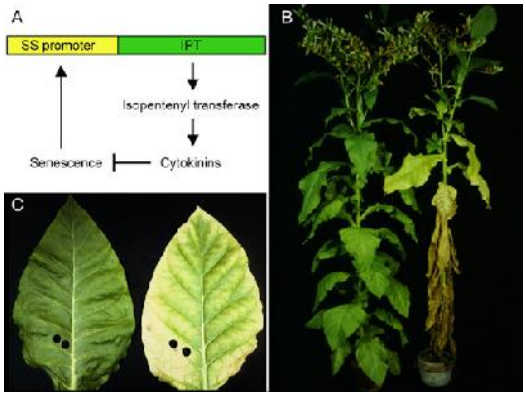
Metabolites
Sugars

Regulation of fruit growth and development

Cytokinins → Berry Size

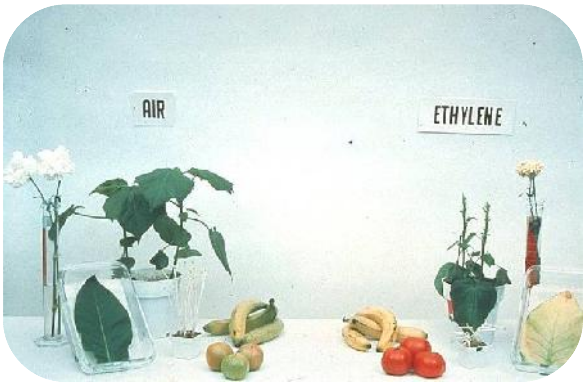
Ethylene → Berry color

"Anti senescence"



Source: S. Gan, Sci. Aging Knowl. Environ. 2003, re7 (2003)

"Senescence enhancer"



Source: Professor Shang Fa Yang class

Transcrip expression of *ACO1* gene in the berry

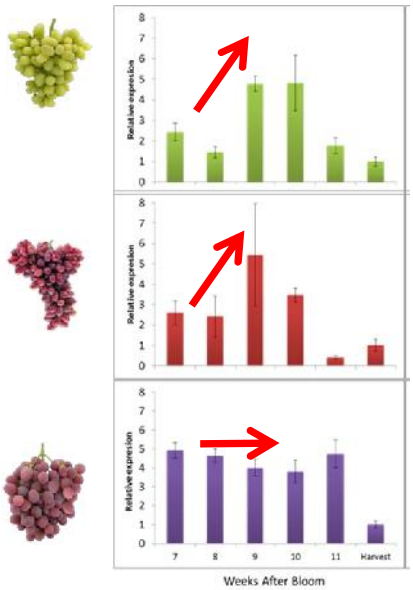
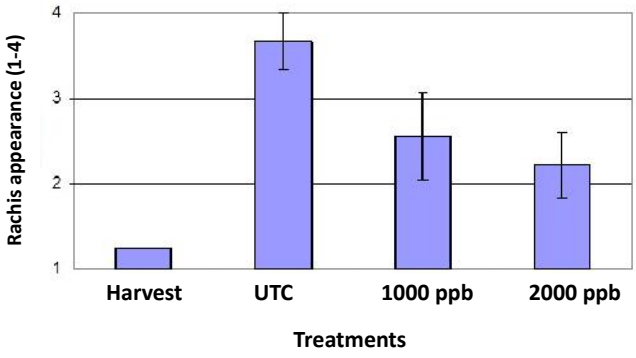


Table grape berries also showed an increase in ethylene metabolism during veraison, but with differences among varieties.

(Muñoz-Robredo, 2013)

Effect of ethylene inhibition (1-MCP) at veraison on rachis appearance in Red Globe



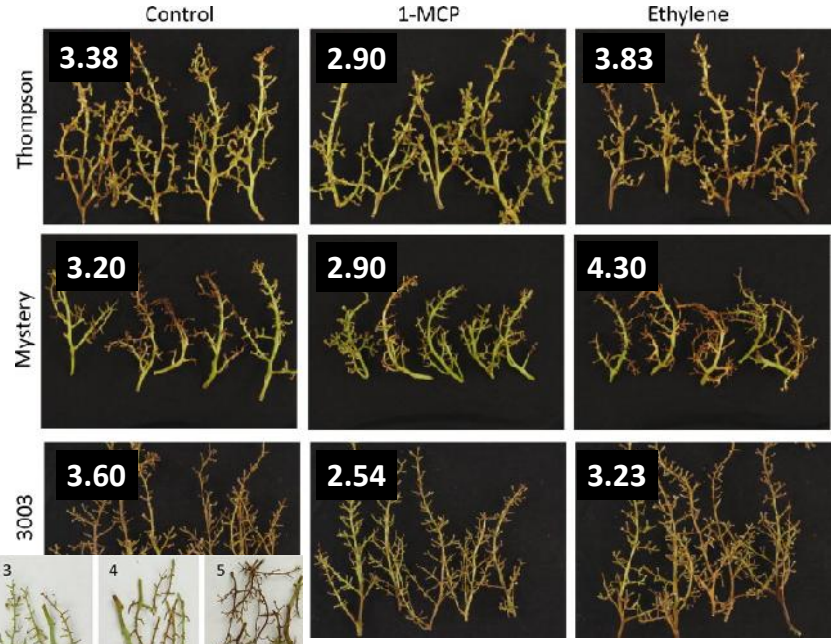
After 60d. at 0°C

UTC

2,000 ppm 1-MCP

*** No consistent effects among seasons**

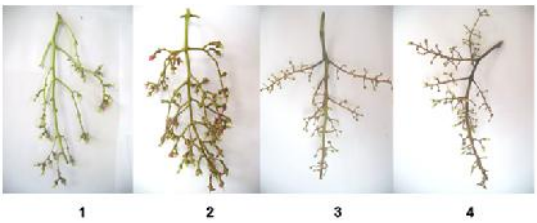
Postharvest Unit, INIA, 2007 (unpublished)



(Li et al., 2015)

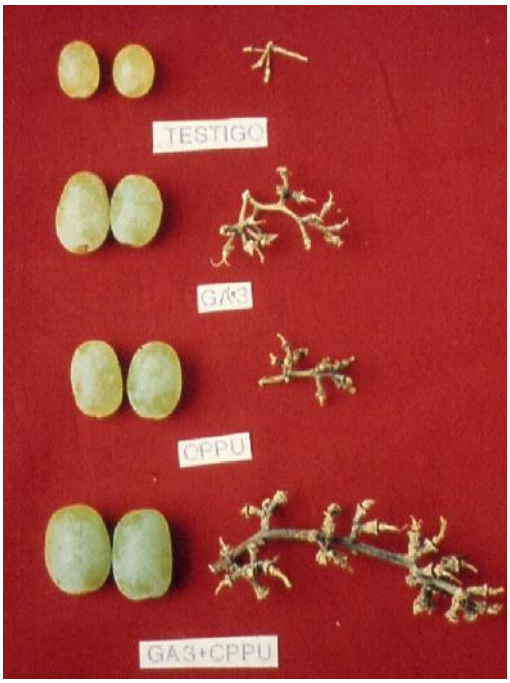
CKs

Treatments	GA_3			
	Grade 1	Grade 2	Grade 3	Grade 4
CKs	21.6	62.4	12.1 a	3.8 a
Thinning	0	20.5	49.3 b	30.3 b
UTC	10.4	31.5	58.1 b	0 a
Factorial: CPPU	s	s	ns	
Thinning	s	s	s	s
C x R	ns	ns	s	s



A >50% greener rachises with GA + CPPU application vs. GA alone.

(Navarro *et al.*, 2001)

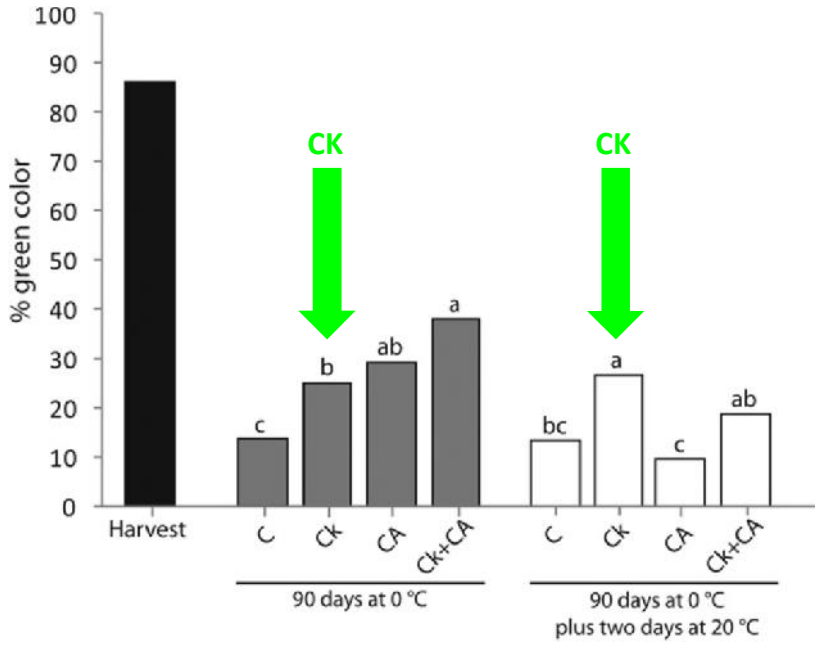


However, it is a must to get a suitable balance between CK´s benefits and detrimental effects in rachis and berry:

- Rachis rigidity
- Stem thickening
- Berry drop

Source: Julio Retamales…in the '90

-Red Globe
-Los Andes, Chile
-400 uL L^{-1} 6-benzyladenine (Valent Biosciences Corp, USA),
-Applied 1 d. before harvest
-Electrostatic sprayer
-Storage: 90 d. at 0°C under RA and CA (5%O_2 and 15% CO_2).



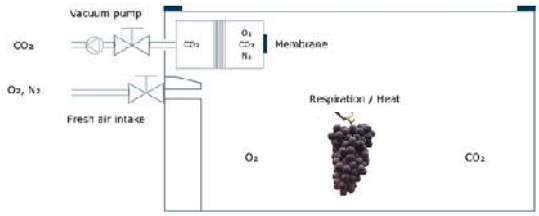
(Balic et al., 2012)

INIA

CONTROLLED AND MODIFIED ATMOSPHERE PACKAGING

Main effects in table grapes:

- ✓ Slow down fruit metabolism.
- ✓ Decay control (CO_2 > 12%).
- ✓ Reduces WVPD…(Increase in RH 92-97% under MAP)



CA: Controlled atmosphere (Container)

MAP: Modified atmosphere packaging

Source: INIA-Subsole…late in the ´90.

Use of controlled atmosphere……late in the ´90s

T. Seedless stored 50 d. at 0°C + 6 d. at 20°C

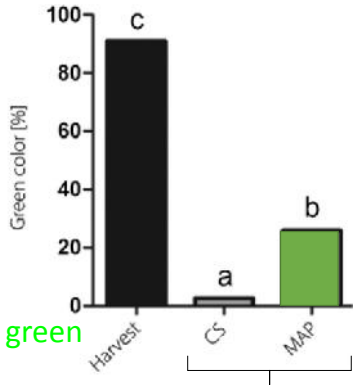
w/ SO_2 pad w/o SO_2 pad

INIA-Subsole

Retamales et al., PBT 2003

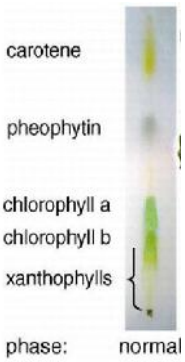
But the use of MAP is able of preserving freshness of the rachis

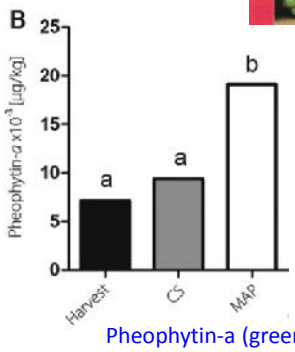
++ green



-- green

90 d. at 0°C



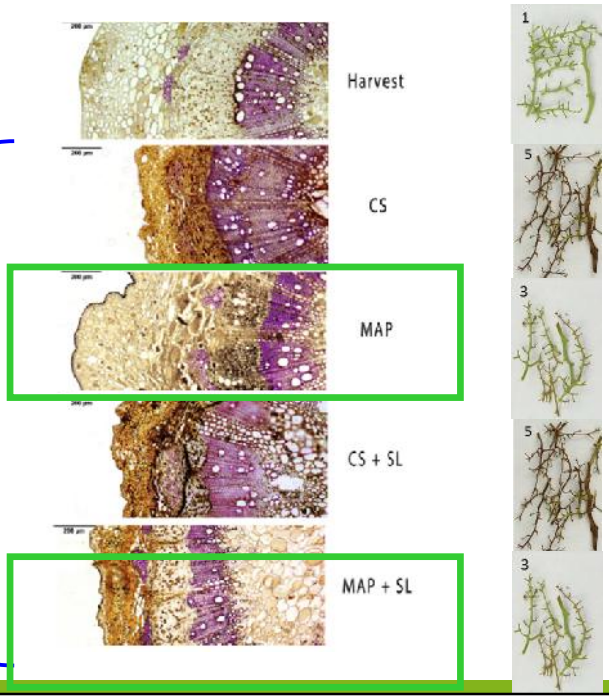


Pheophytin-a (green yellowish pigment)

(Silva-Sanzana et al.,2016 . Fondecyt UNAB-INIA)

Tranversal slices from rachis stained with **phloroglucinol-HCl** to facilitate recognition of lignified vascular tissue.

After 90 d. at 0°C



(Silva-Sanzana et al., 2016)

Final remarks for rachis…..actually for everything related to grape quality

- WVPD control is a must….think in **the rachis** more than in the berry. **LOGISTIC!!**
- A lot of to learn about **new genotypes:**
  - ✓ Preharvest conditions (Climate and cultural management)
  - ✓ Maturity at harvest
  - ✓ Storage potential
  - ✓ PGRs response
- Alternatives to SO_2 for decay control…what about the rachis?
- Rachis **science** & **technology**

Working team

POSTHARVEST UNIT:

Sebastián Rivera
Edgard Alvarez

Reinaldo Campos-Vargas

BREEDING PROGRAM

Paola Barba
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CORFO

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August 17th &18th , 2020.