Optimum harvest date and storage of plums
the latest research at InHort

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4th EUFRIN Plum and Prune WG meeting
"Challenges of Plum Growing in Europe"

5–7 September 2018
Jelgava, Latvia

Objective

Summary/scanning of existing results/knowledge from experiments carried out last decade at InHort (Skierniewice, Poland), focused on predicting optimum harvest date and storability of plums was done in the frame of InnoFruit Project, .

Quality characteristics

Consumer acceptance is high for fruit with high total soluble solid content TSS. Titratable acidity (TA), and TSS:TA ratio, are also important factors in consumer acceptance.

Fruit size, skin / flesh colour and fruit firmness are also important quality parameters.

Measurement of fruit quality parameters

Colour

Fruit colour could be determined as a skin colour (background and blushed) or/and as a percentage of surface of blush.

Skin colour (flesh colour) could be measured instrumentally using a spectrometer (Minolta, HunterLab or equivalent).

Measurement of fruit quality parameters

Colour

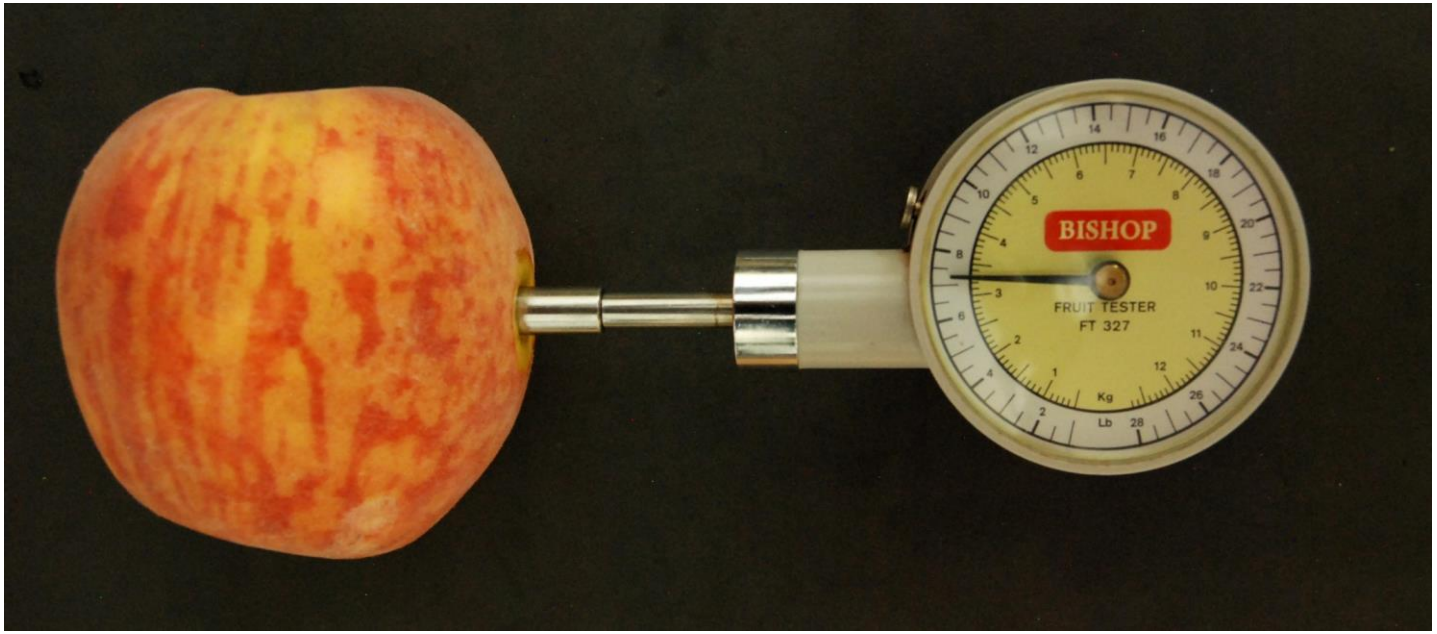
Measurement of fruit quality parameters

Colour

Measurement of fruit quality parameters

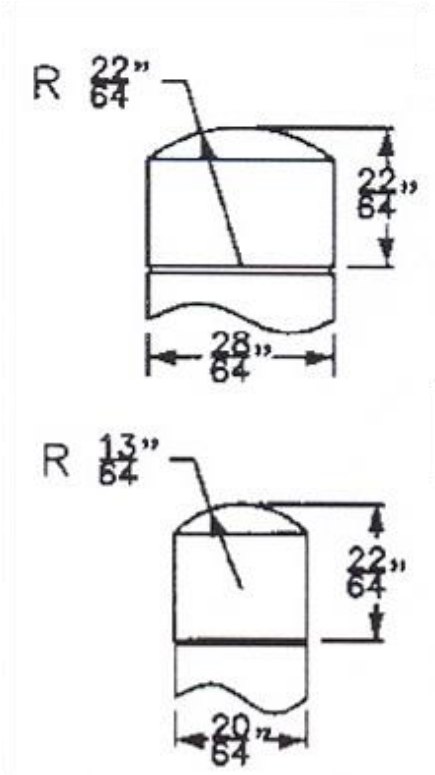
Fruit firmness

The fruit firmness is the maximum force necessary to push a plunger of specified size and shape into the flesh of the fruit up to specific depth.



Measurement of fruit quality parameters

Fruit firmness



Magness-Taylor

Measurement of fruit quality parameters

Fruit firmness

There are various type of penetrometers available

Measurement of fruit quality parameters

Fruit firmness

Fruit firmness of plums can be measured as an puncture test and/or deflection of surface.

Puncture test – penetrometer with 8 mm tip

Measurement of fruit quality parameters

Total soluble solids content

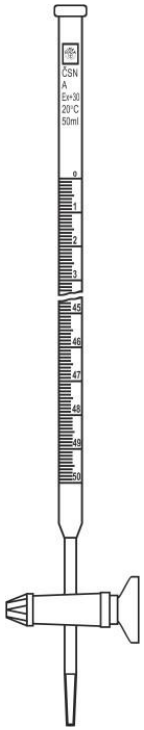
Determination of total soluble solids by refractometer (TSS) is based on the capacity of sugars or other water-soluble substances in a juice to deviate light.

There are various hand-held refractometers available (as well as digital battery/mains operated)

Measurement of fruit quality parameters

Titratable acidity

The simplest method for determination of titratble acidity is titration of juice sample using burette with 0.1N NaOH, elektromagnetic stirrer and pH Metter or phenolphthalein as indicator of pH.



Measurement of fruit quality parameters

Titratable acidity

The easiest and fastest method for determination of titratable acidity is titration using automatic titrators.

There are various automatic titrators available as well.

Measurement of fruit quality parameters

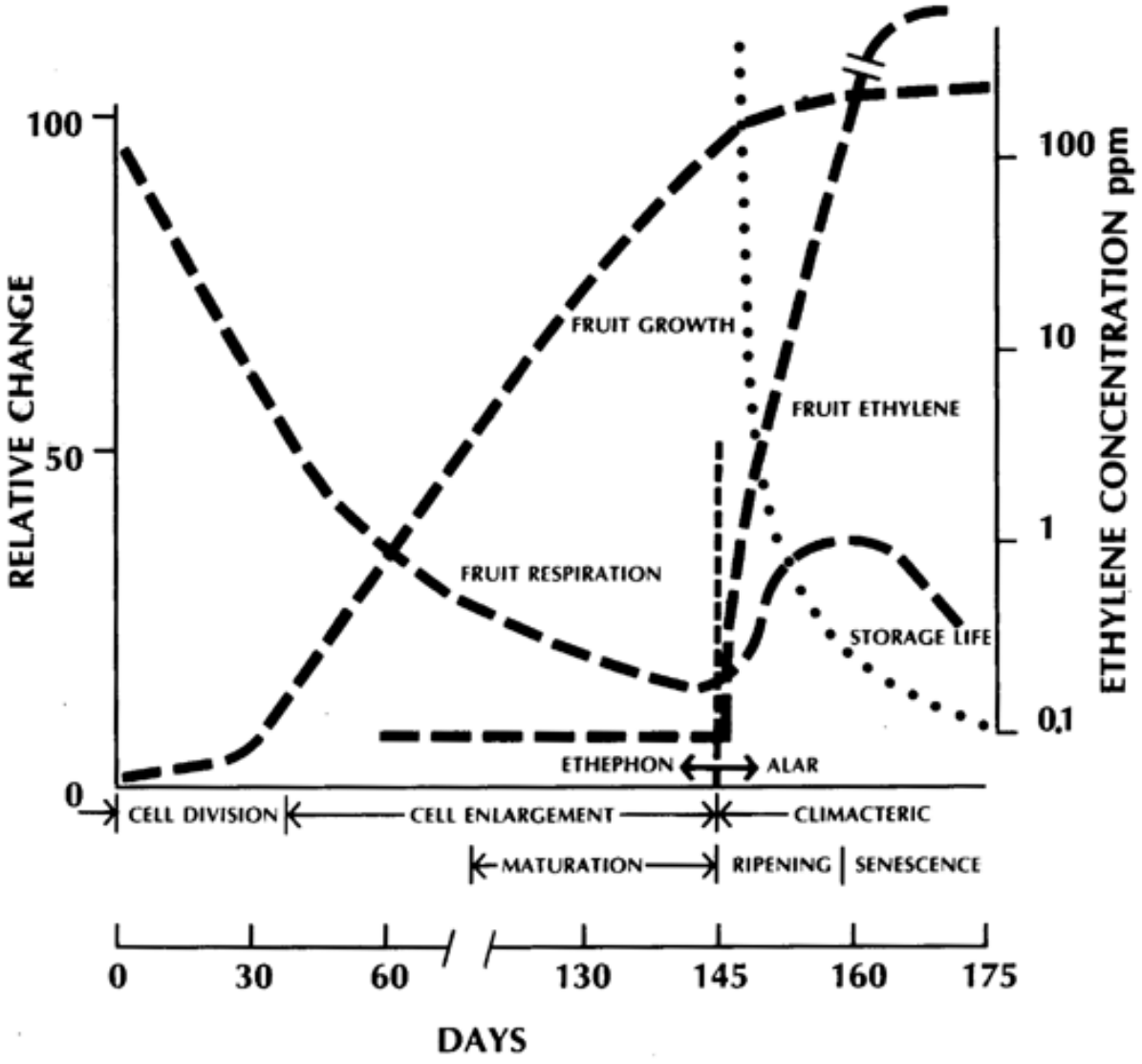
Titratable acidity

The standard methods for determination titratable acidity is based on titration the juice with 0.1 N NaOH to the end point pH=8.1. The end point may be determined using a coloured indicator (phenolphthalein) or using the pH meter.

The measurements may be performed on the same juice, prepared for TSS determination.

The titratble acidity could be expressed as percentage of predominant acid.

Optimum harvest date



Ethylene production and respiration rate

Ethylene production rates are:

0.01 to 5 µL kg^{-1} h^{-1} at 0 °C,
0.02 to 15 µL kg^{-1} h^{-1} at 5 °C,
0.04 to 60 µL kg^{-1} h^{-1} at 10 °C,
and 0.1 to 200 µL kg^{-1} h^{-1} at 20 °C.

The lower end of this range is for mature but unripe fruit; higher values are for ripe fruit.

Respiration rates are:

2 to 3 mg CO_2 kg^{-1} h^{-1} at 0 °C
8 to 12 mg CO_2 kg^{-1} h^{-1} at 10 °C
16 to 24 mg CO_2 kg^{-1} h^{-1} at 20 °C

To get mL CO_2 kg^{-1} h^{-1}, divide the mg kg^{-1} h^{-1} rate by 2.0 at 0 °C (32 °F), 1.9 at 10 °C (50 °F), and 1.8 at 20 °C (68 °F).
To calculate heat production, multiply mg kg^{-1} h^{-1} by 220 to get BTU ton^{-1} day-1 or by 61 to get kcal $tonne^{-1}$ day^{-1}.

HB 66, USDA

Maturity indices

Fruit firmness (puncture test and/or deflection of surface), skin/flesh colour (cultivar dependent), ethylene/CO_2 production are good indicators of ripening

Firmness, measured by squeezing fruit in the palm of the hand, can be also a useful maturity index.

VIS/NIR non-destructive techniques can be used for estimation of fruit maturation and quality

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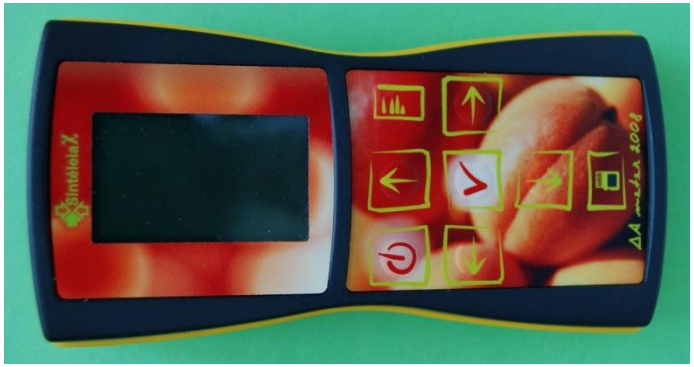
VIS/NIR non-destructive techniques can be used for estimation of fruit maturation and quality

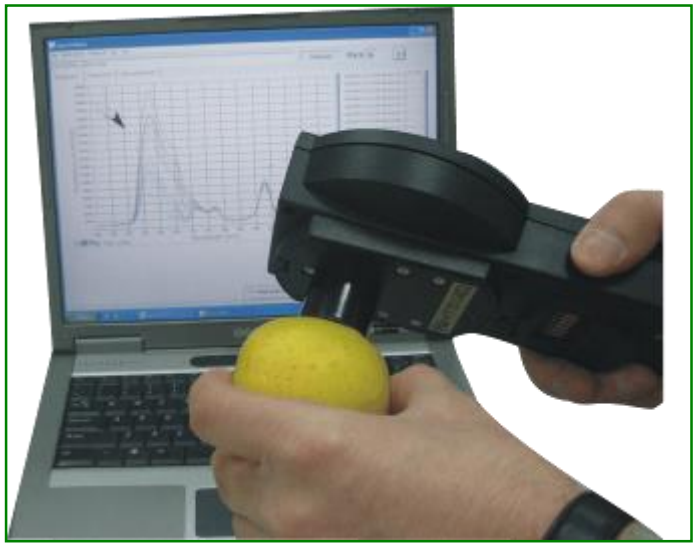
VIS/NIR nondestructive techniques

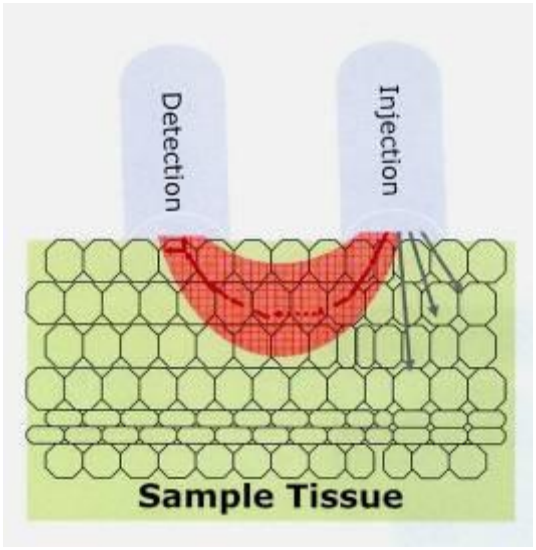


DA meter,
Sintéleia,
Italy

CP Pigment Analyzer PA1101,
Control in Applied Physiology GbR.,
Germany

VIS/NIR nondestructive techniques





CP Pigment Analyzer PA1101
Control in Applied Physiology GbR., Germany

VIS/NIR nondestructive techniques

The three indicies: DA, NDVI and NAI were gathered from the instruments.

DA Meter

The DA index is calculated using formula

$$\mathbf{DA=A670-A720},$$

where A670 and A720 are absorbances at respective wavelengths of 670 and 720 nm.

VIS/NIR nondestructive techniques

CP Pigment Analyzer

The NDVI (Normalized Difference Vegetation Index) is calculated using formula

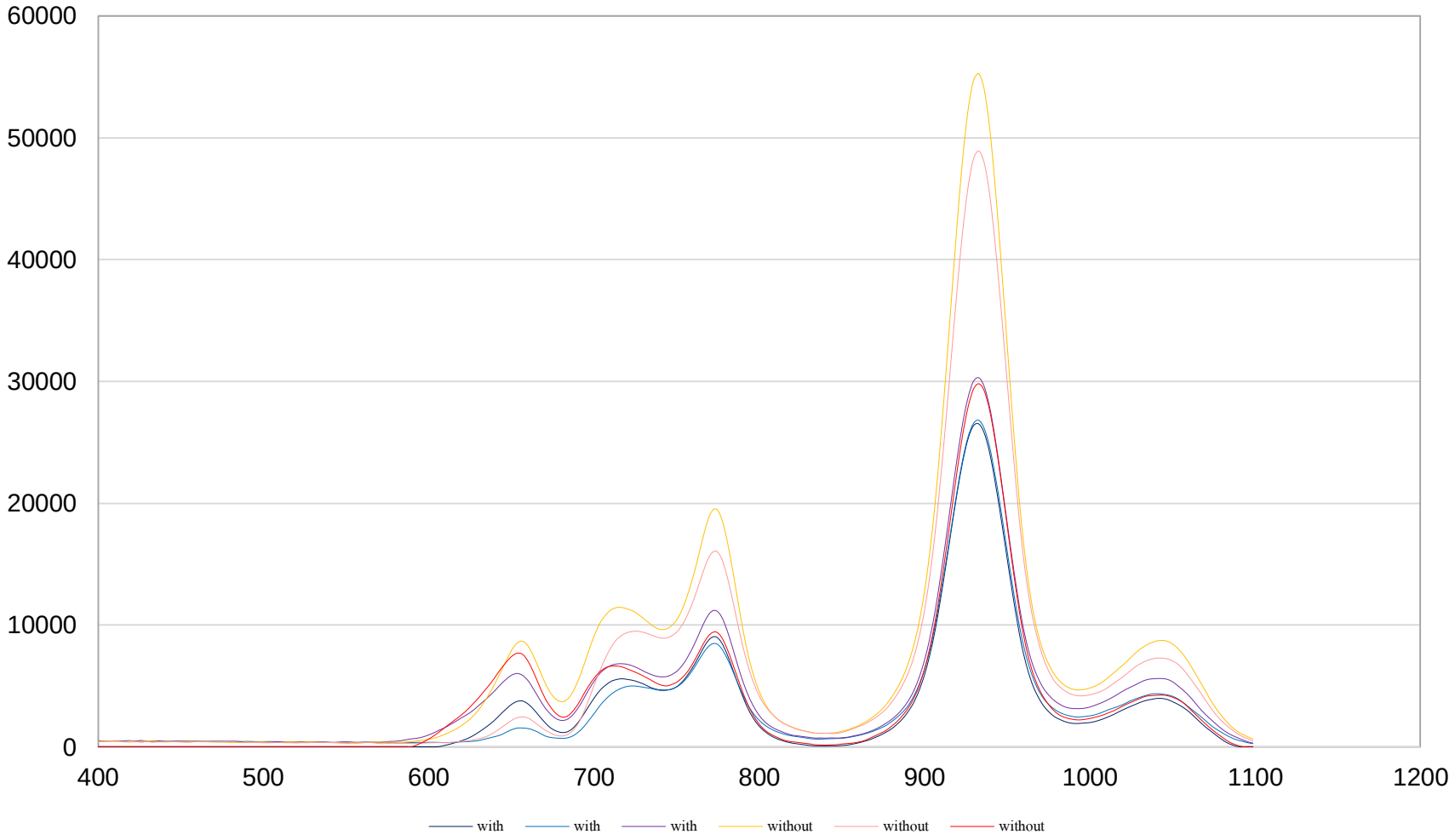
$$NDVI=(I780-I660)/(I780+I660),$$

the NAI (Normalized Anthocyanin Index) is calculated using formula

$$NAI=(I780-I550)/(I780+I550),$$

where I550, I660 and I780 are reemitances at respective wavelengths of 550, 660 and 720 nm.

VIS/NIR nondestructive techniques



Storage

- Temperature (range from -1.1 °C to 0 °C)
- Relative humidity (90-95%)
- Composition of the storage atmosphere
  - Air – normal atmosphere
  - Modified atmosphere
  - Controlled atmosphere
    - 3-5% CO_2 + 1-3% O_2
- Other systems
  - Xtend®
  - „Bag containers” (individual gas conditions per pallet)
  - JannyMT

Storage

Xtend®
MA/MH packaging

Storage

Xtend®
MA/MH packaging

Storage

Xtend®
MA/MH packaging

http://www.stepac.com/pages/xtend

Storage

http://www.van-amerongen.nl

http://www.storex.nl

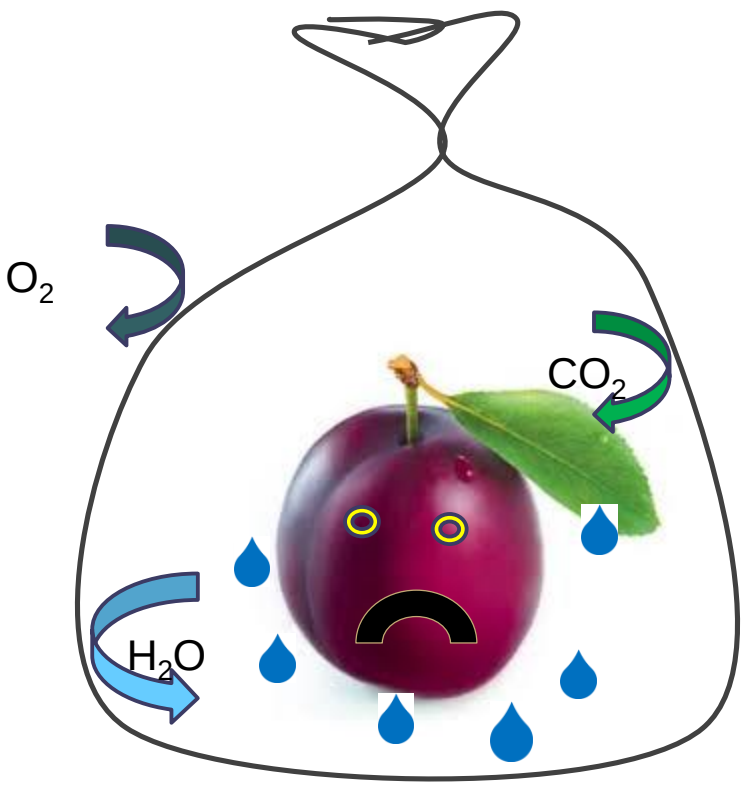
Storage

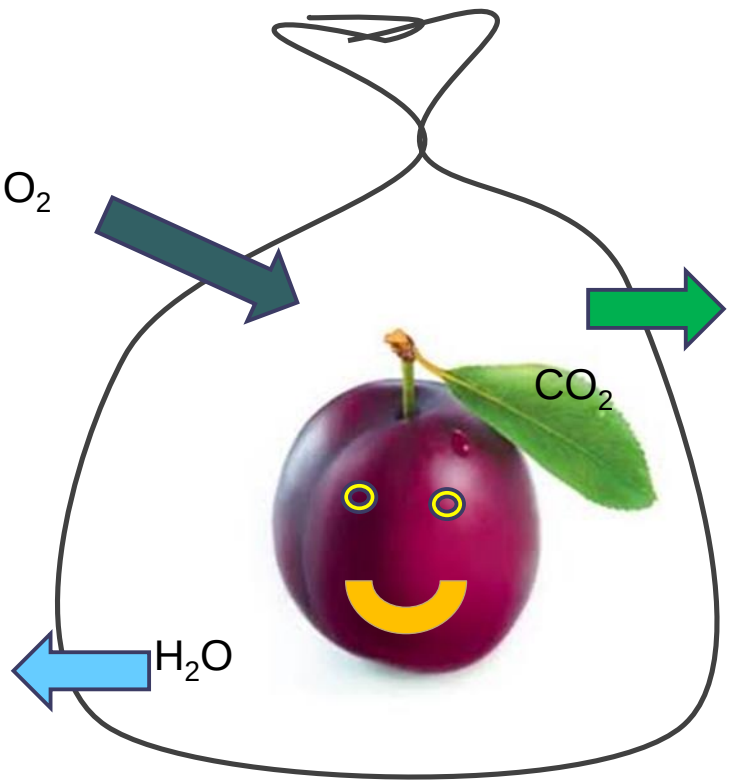

JANNY MT
MODULES INDIVIDUELS D'ATMOSPHÈRE CONTRÔLÉE


TIEMPO-Cap

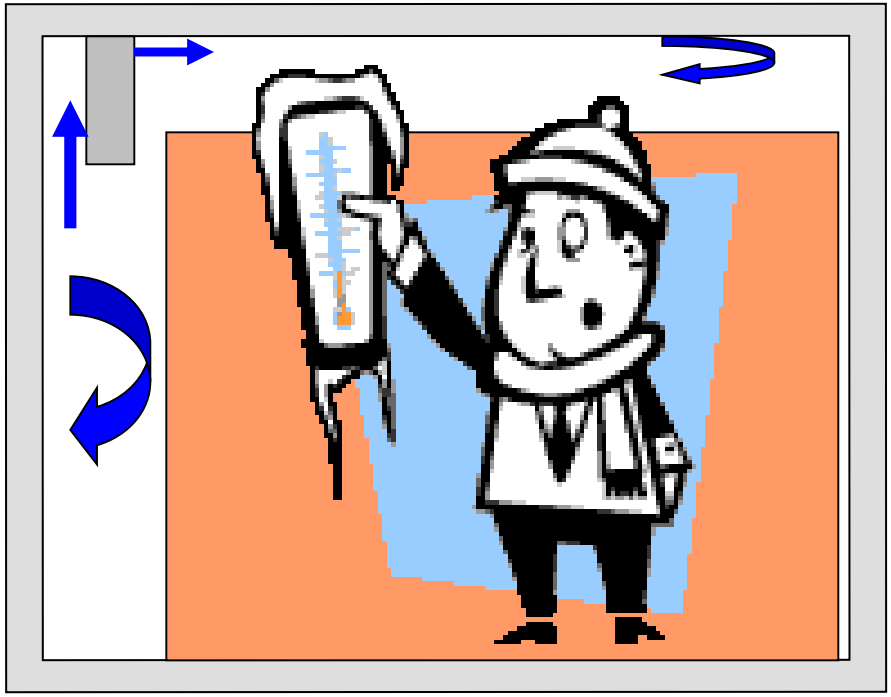
Storage

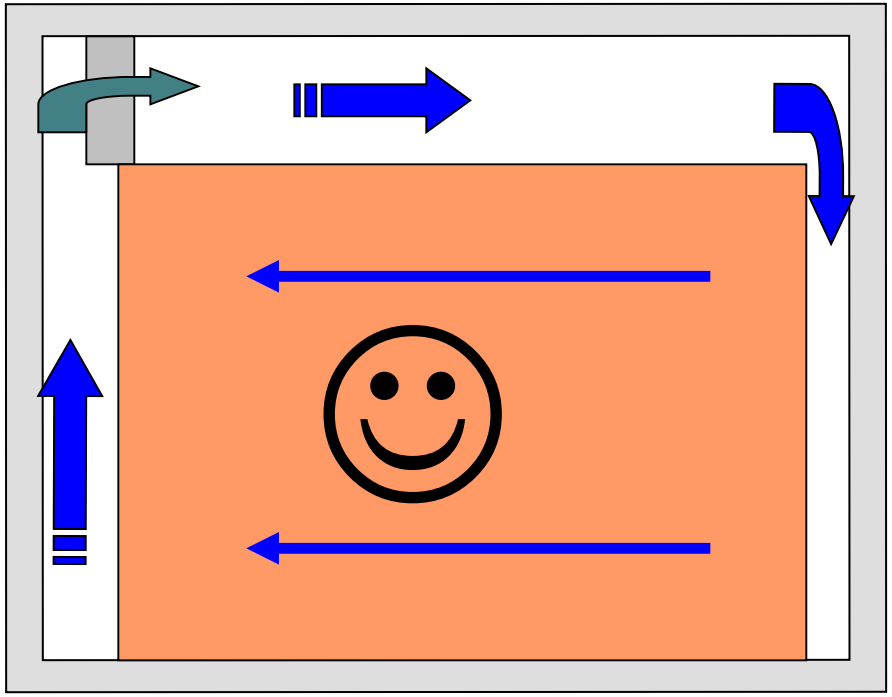
Storage





Storage





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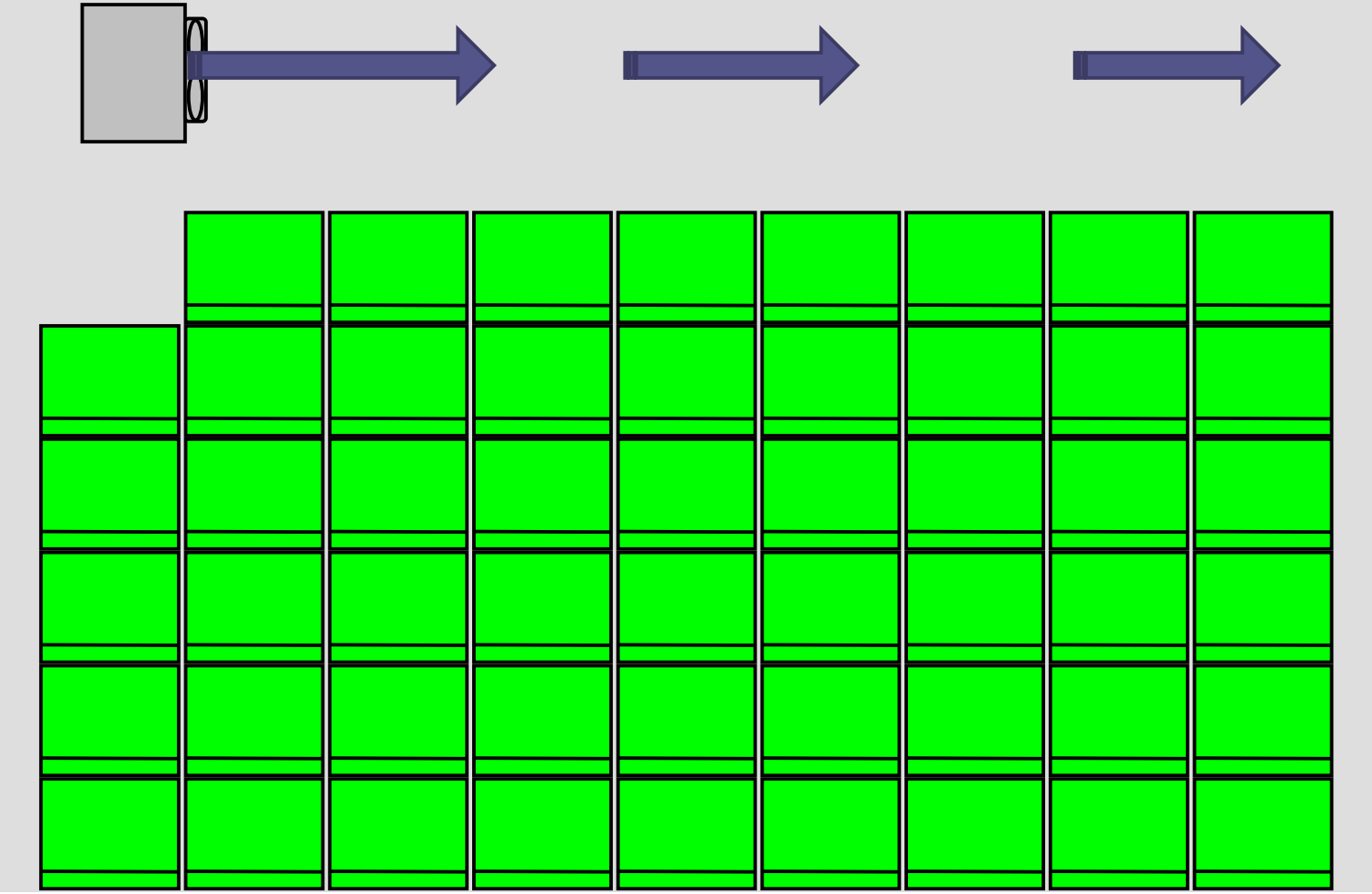

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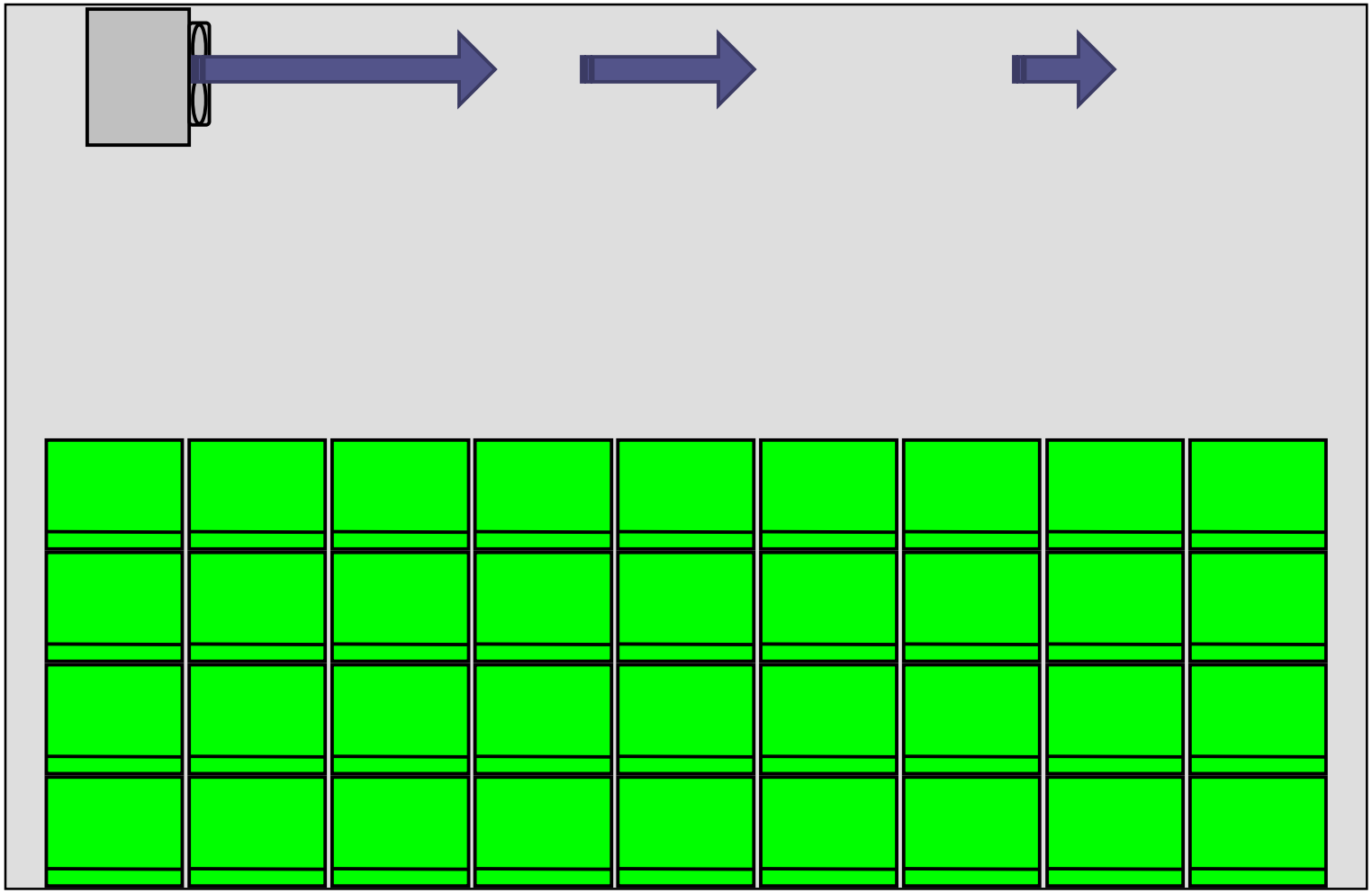

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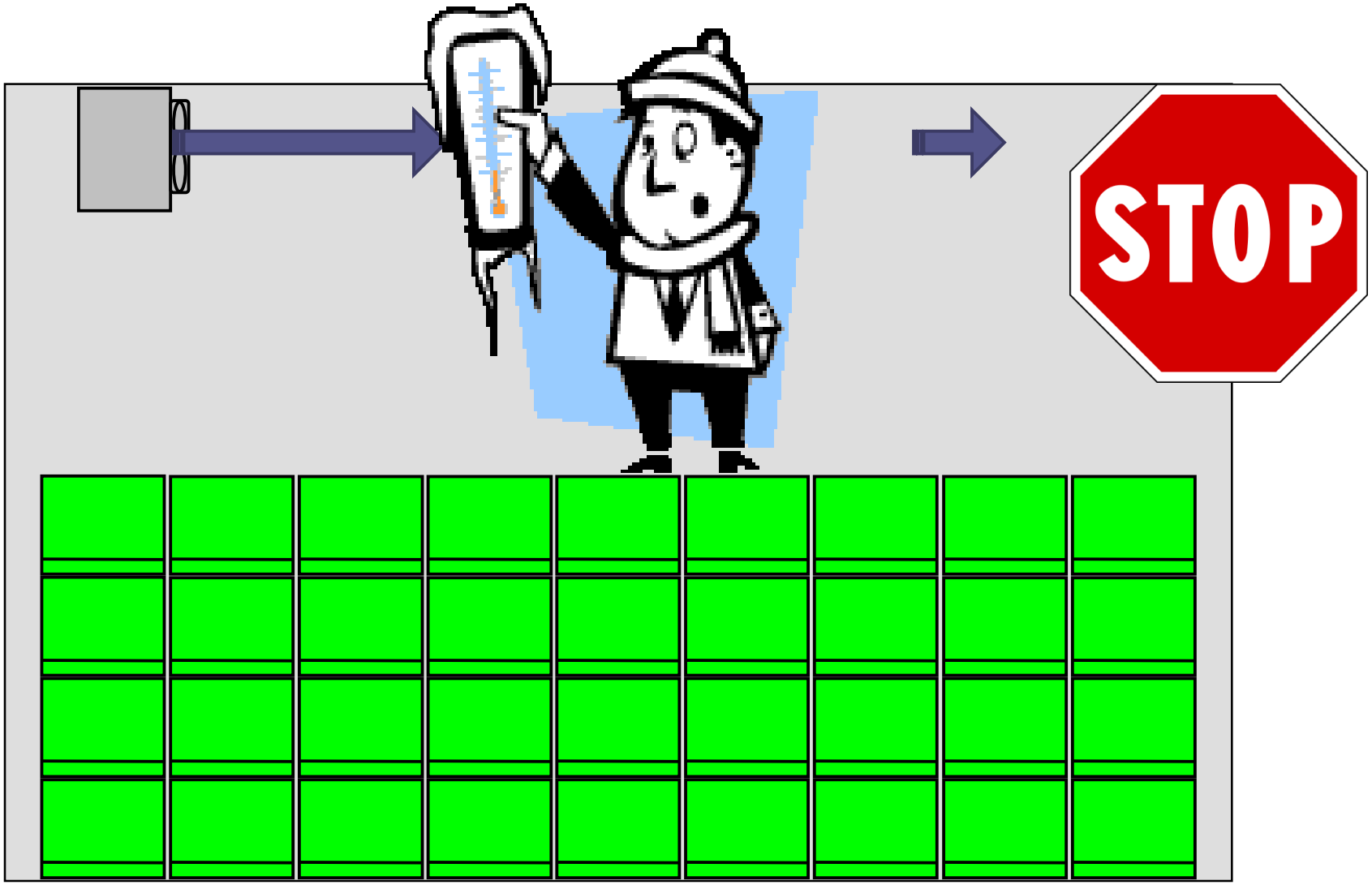
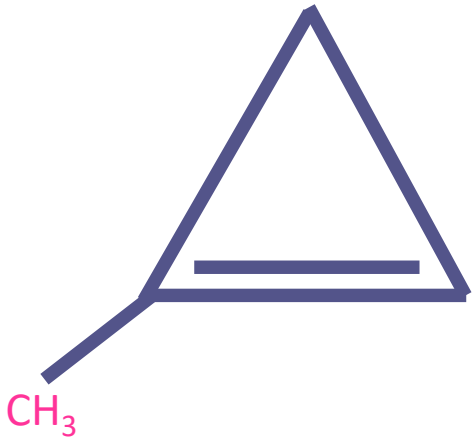
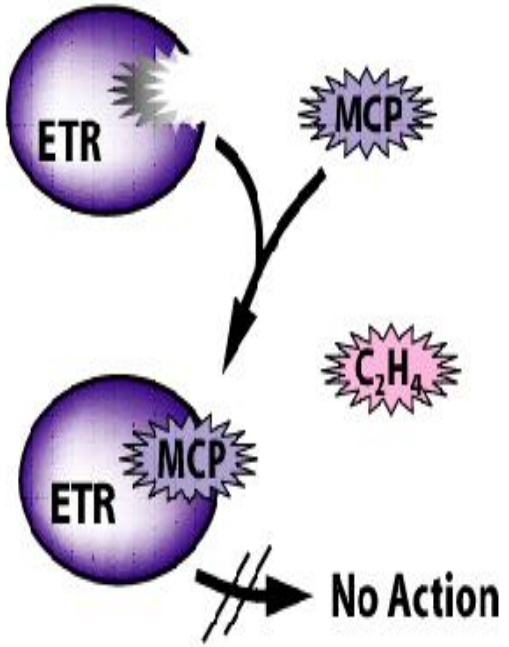


1-MCP postharvest treatment

1-MCP

(1-methylcyclopropene)

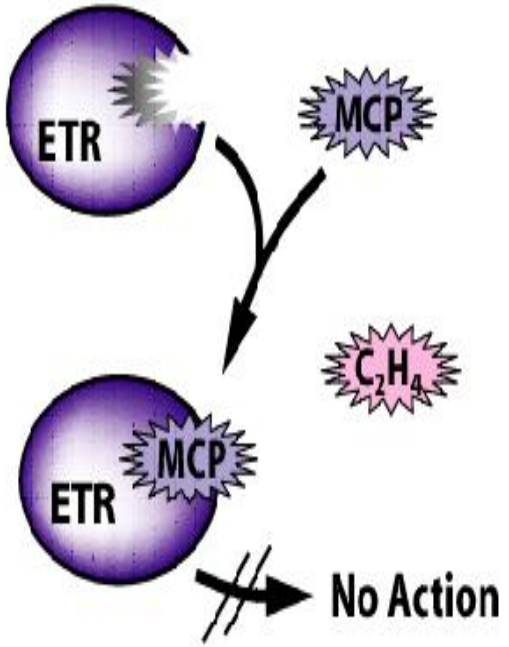




Patent: Sisler and Blankenship, NC; 1996

1-MCP postharvest treatment

- Efficiency due to 1-MCP influence on metabolic processes linked to production of ethylene;
- 1-MCP binds to ethylene receptors in cell membranes;
- Typically 1 application after harvest.



Results

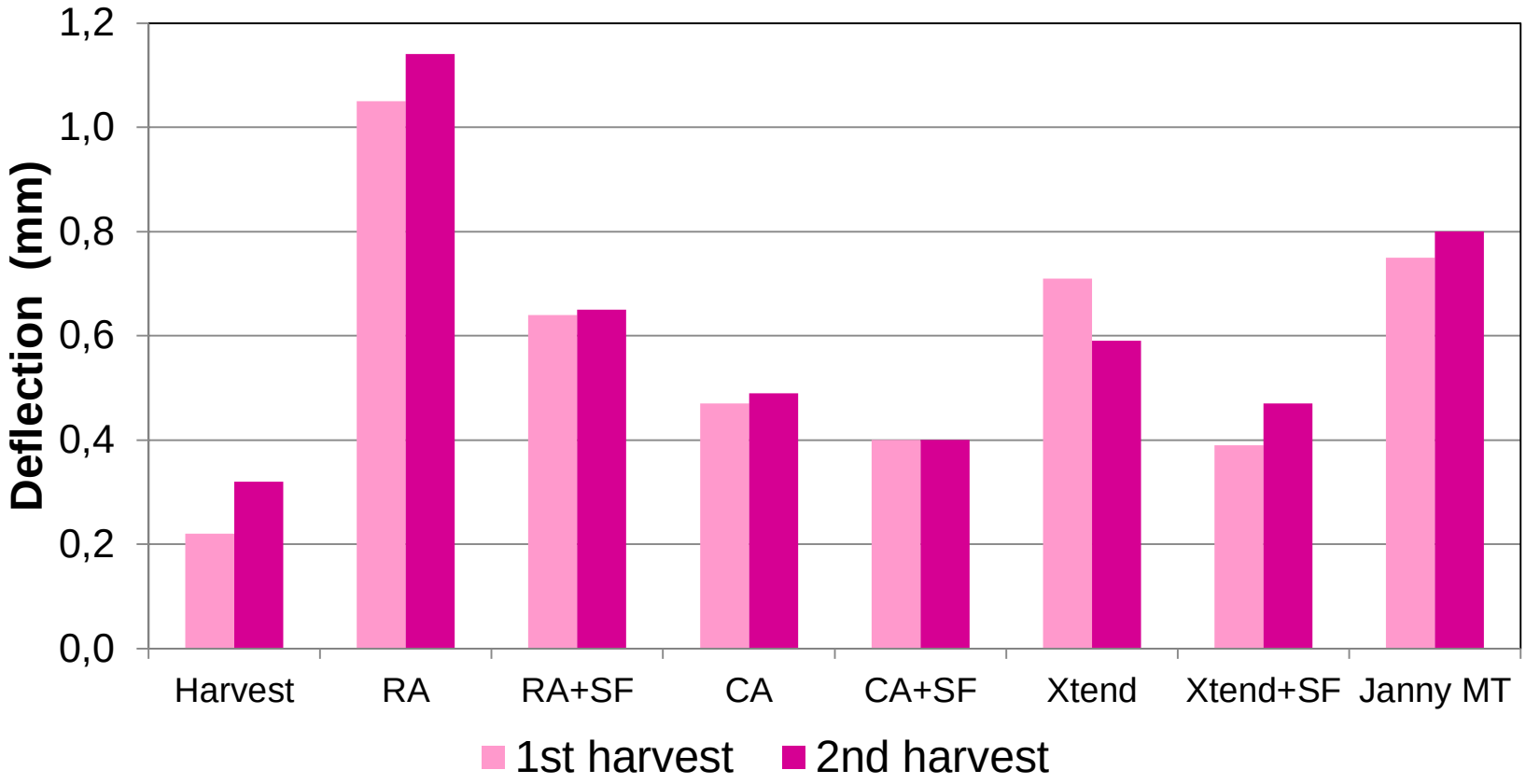
The influence of harvest date and storage conditions on fruit flavour.

Storage conditions	After 91 days of storage		After add. 4 days shelflife	
	1st harvest	2nd harvest	1st harvest	2nd harvest
RA	4.5 a	5.0 a	3.4 a	-
RA + SmartFresh	5.8 a	6.2 a	4.4 ab	4.7 a
CA	5.2 a	5.4 a	4.9 ab	6.0 a
CA + SmartFresh	4.9 a	5.6 a	5.3 ab	6.1 a
Xtend	5.7 a	5.6 a	4.6 ab	5.8 a
Xtend + SmartFresh	5.4 a	4.8 a	5.8 b	5.5 a
Janny MT	5.1 a	6.2 a	3.8 ab	4.9 a

*Averages with the same letters in column are not significantly different according to Tukey' test at $p < 0.05$

Rutkowski et al. CAMA2013

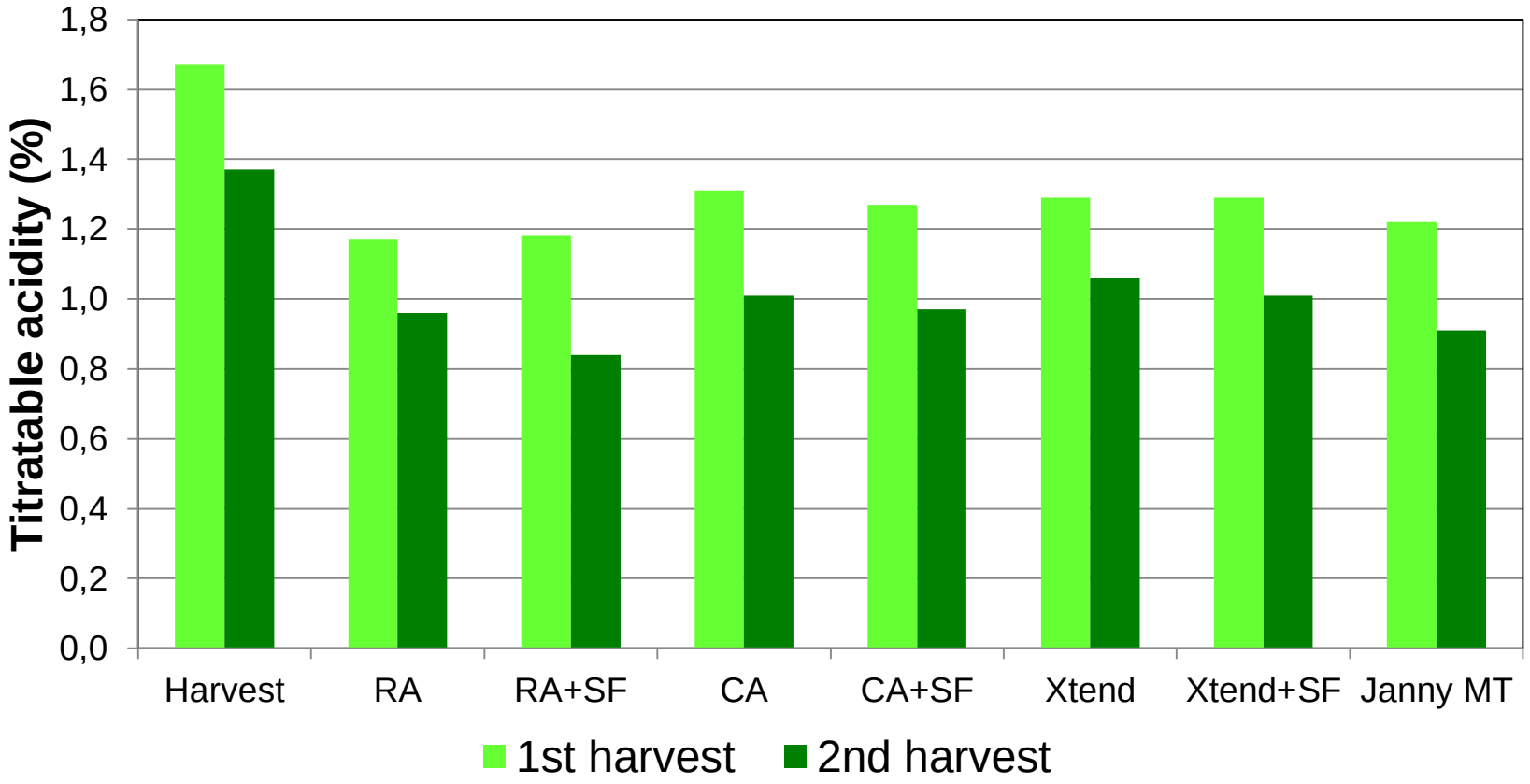
Results



The influence of harvest date and storage conditions on fruit ripening (softening) of plums cv 'President'

Rutkowski et al. CAMA2013

Results



The influence of harvest date and storage conditions on titratable acidity of ‚President' plums

Rutkowski et al. CAMA2013

Results

The influence of SmartFresh treatment on incidence of internal disorders of ‘President’ plums stored in RA

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Upper row – RA; lower – RA + SmartFresh.

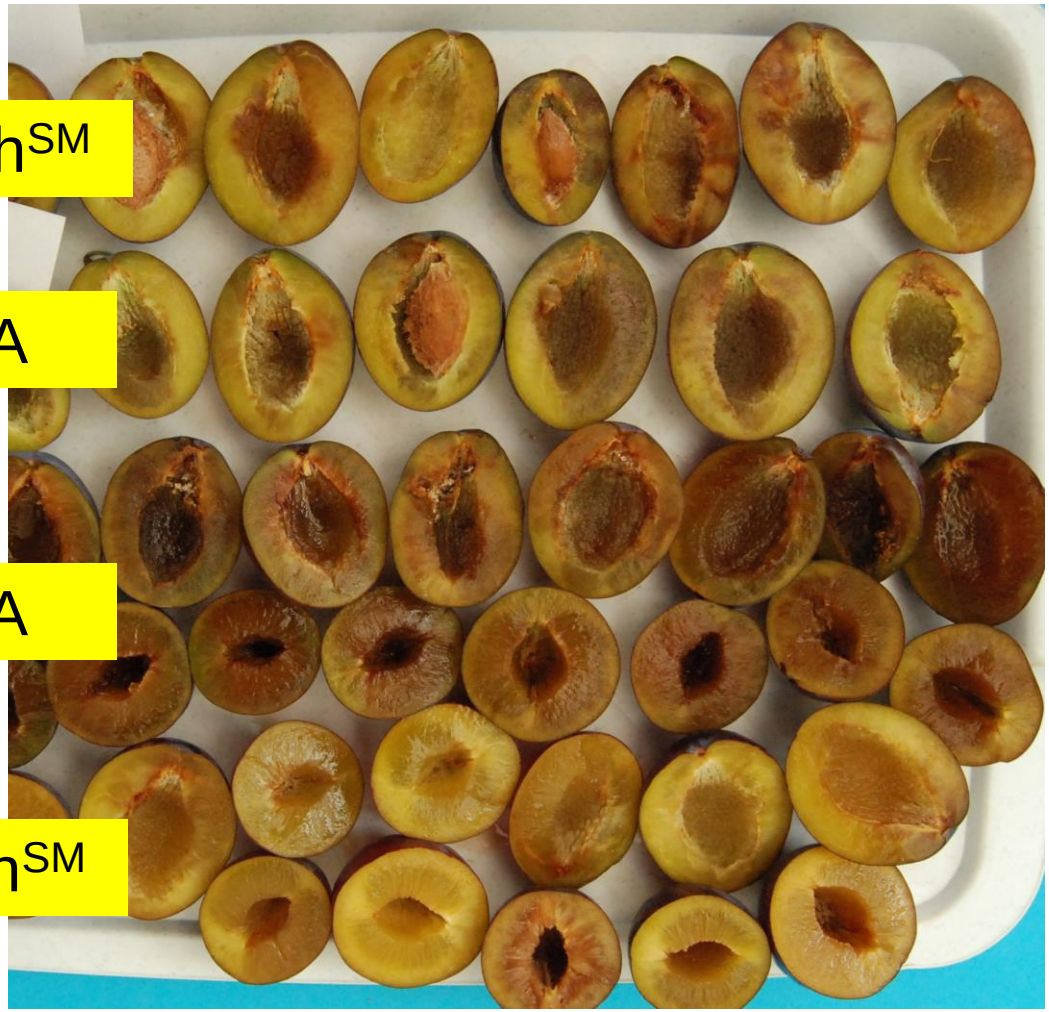
Results

CA + SmartFresh^{SM}

CA

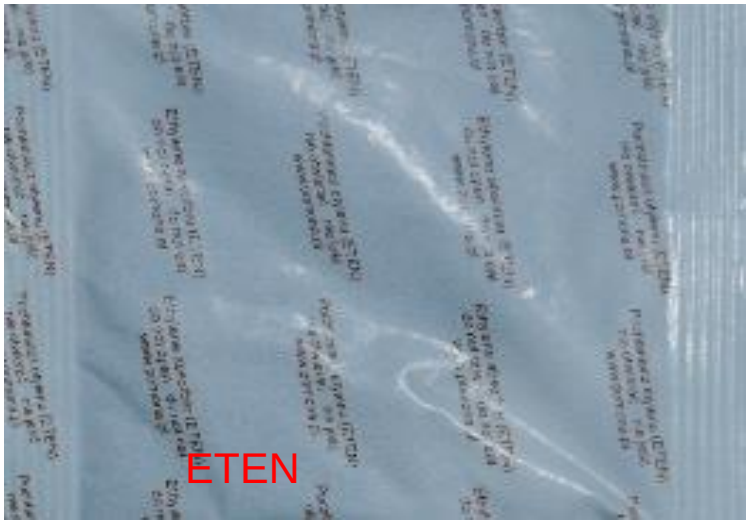
RA

RA + SmartFresh^{SM}



Storage

Is it necessary to remove the ethylene from storage atmosphere?



Conclusions

1. Fruit firmness (puncture test and/or deflection of surface), skin/flesh colour (cultivar dependent), ethylene/CO2 production are good indicators of ripening
2 .VIS/NIR non-destructive techniques can be used for estimation of fruit maturation and quality
3. Depending on variety and ripening stage at harvest, plums can be stored up to 4 months at cold store (-0.5 to +1.0 °C) under regular (RA) or controlled (CA - 3% O2 + 5% CO2) atmosphere. Innovative systems, Xtend® and JannyMT, can be used to extend storage period in RA. Further investigation needed.
4. Postharvest treatment with 1-MCP (SmartFreshTM) inhibit ripening and reduce incidence/severity of internal disorders.
5. Reduction of biological variability in quality and maturity at harvest is necessary to reduce storage loses due to disorders/diseases.

Acknowledgement

This work was performed in the frame of Interreg Baltic Sea Region Programme,

Project InnoFruit:

Advancement of nontechnological innovation performance and innovation capacity in fruit growing and processing sector in selected Baltic Sea Region countries.

Project co-financed by the EU from the European Regional Development Fund

Announcement

In 2019 (June) the 4th International Conference „Effect of Pre- and Post-harvest Factors on Health Promoting Components and Quality of Horticultural Commodities” will be held in Skierniewice, Poland

The first announcement will be available soon on web site of InHort (also send by email).


Thank you for
your attention