Influence of packaging configuration on postharvest quality and physiological responses of table grapes during cold storage and shelf life

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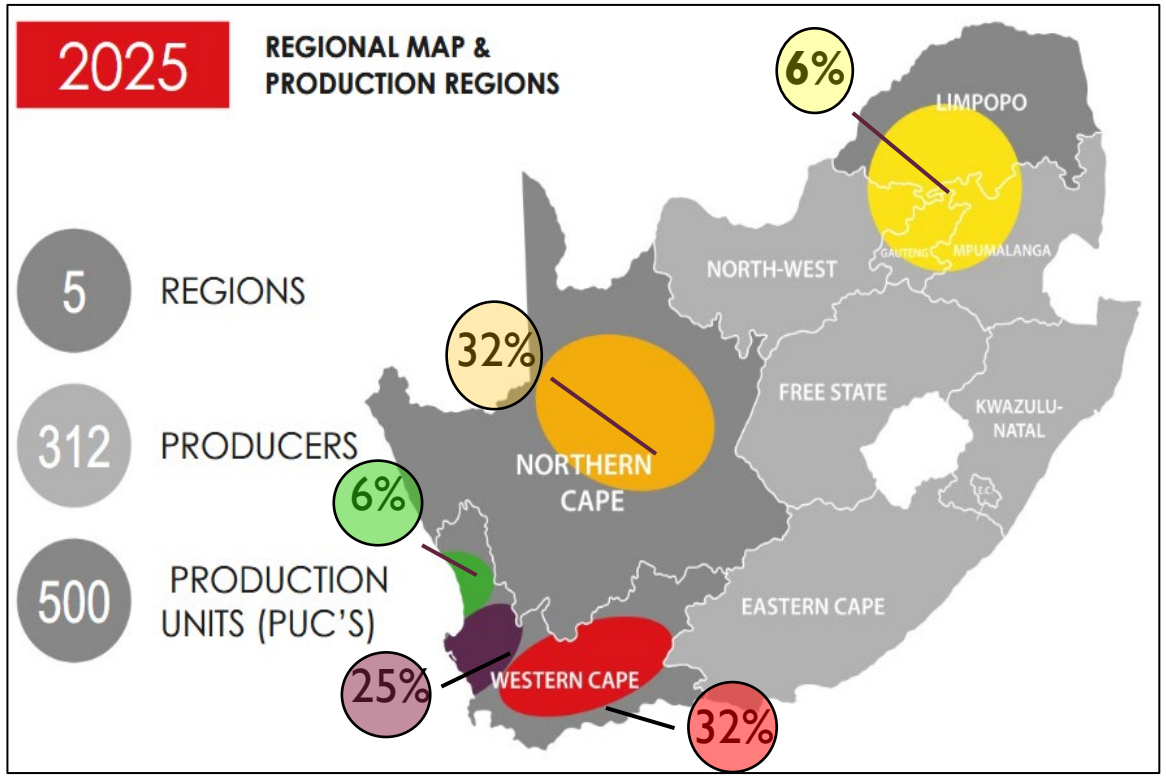
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Background

South Africa's Table Grape Industry & Current Storage Practice

- Table grapes are a high-value South African export crop and a major share of fresh fruit consumption
- The 2024/25 season was a record year for the industry, achieving the highest export volume to date
- Total exports reached 78.2 million (4.5 kg) cartons, with 78.9 million cartons inspected during the season



(SATI statistics of table grapes in South Africa, 2025)

Scientific Gap & Opportunity

Knowledge Gaps Remain Regarding Conditions Inside the Package

- **Microenvironment not characterised**
- **Fruit-level variability**
- **Link between storage conditions and physiology**



Problem, Aim & Objectives

Problem statement

- Package-level microenvironments and their effects on table grape physiology during cold storage are not yet fully characterised, limiting the industry's ability to optimise packaging and cold-chain management

Aim

- To investigate the effects of commercial table grape packaging on the fruit microenvironment and physiological responses during cold storage and shelf life

Objective

Determine the physiological responses of grapes (rachis browning, decay incidence and berry shatter) under different microenvironmental conditions *(*Cold storage (42 days of cold storage) and Shelf-life (7 days))

Study Design: Overview
Materials & Methodology

Objective 1: Determine the physiological responses of grapes (respiration, water loss, rachis browning) under different microenvironmental conditions(Cold storage (42 days of cold storage) and Shelf-life (7 days))

Box design

A and B

x

Liner perforation

96×5mm and 120×5mm

x

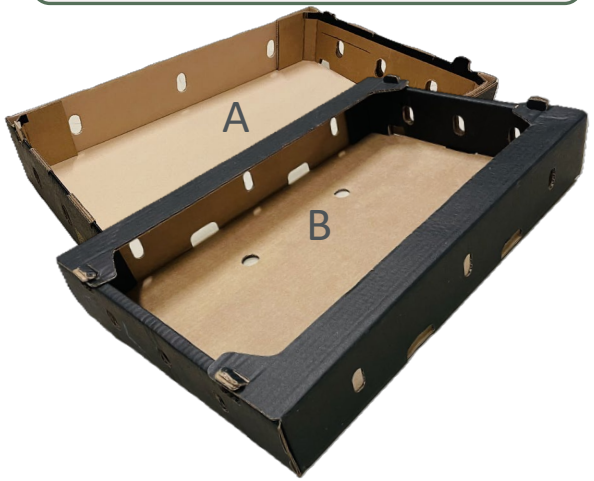
SO_2 treatment

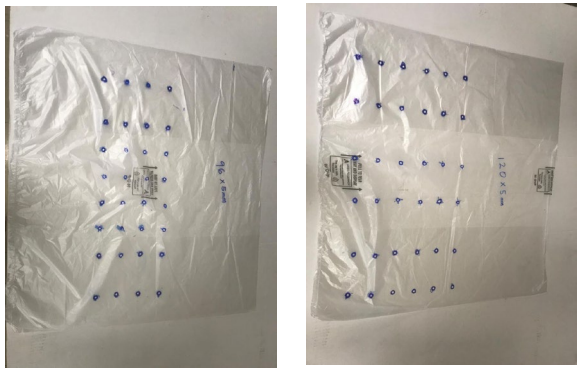
Control and SO2 treated

x

Cultivar

3 cultivars





Liner 96×5mm , Liner 120×5mm





Autumn Crisp, Crimson Seedless, and Sweet Globe

Table grapes obtained from De Vlei Packhouse, Western Cape, South Africa

Materials & Methodology continued

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Rachis browning (1-5)-scoring scale

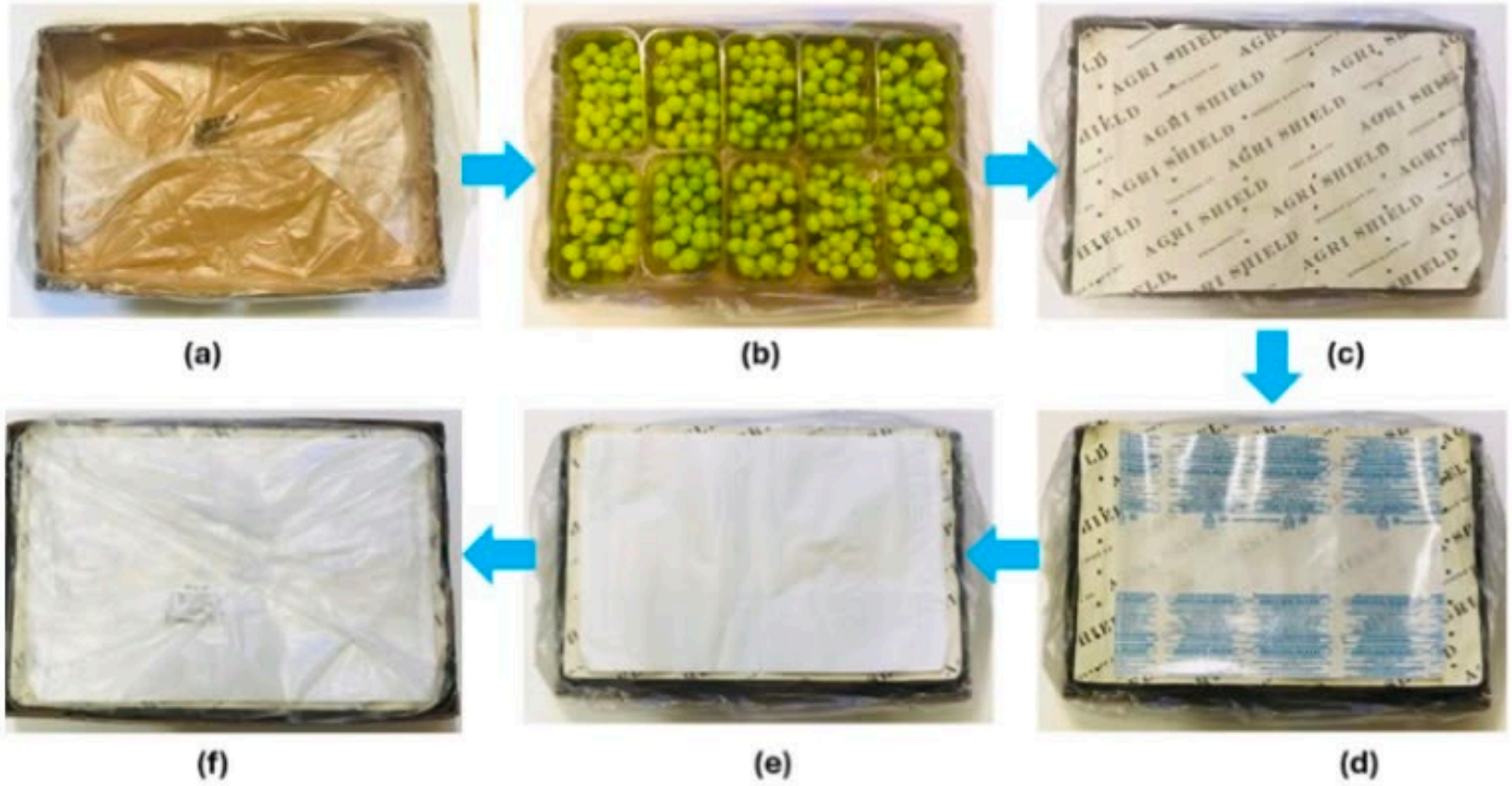


Materials & Methodology continued

- Weight loss(%)- Digital balance
- Respiration rate- gas analyser and jars
- Total soluble solutes (°Brix)-Refractometer
- Titratable acidity (TA)-Metrohm 862 small titrosampler

Methods and Material continued

Packaging Method



a) Liner placement inside box

b) Punnets inside the box with liner

c) SO_2 guard sheet

d) SO_2 sheet

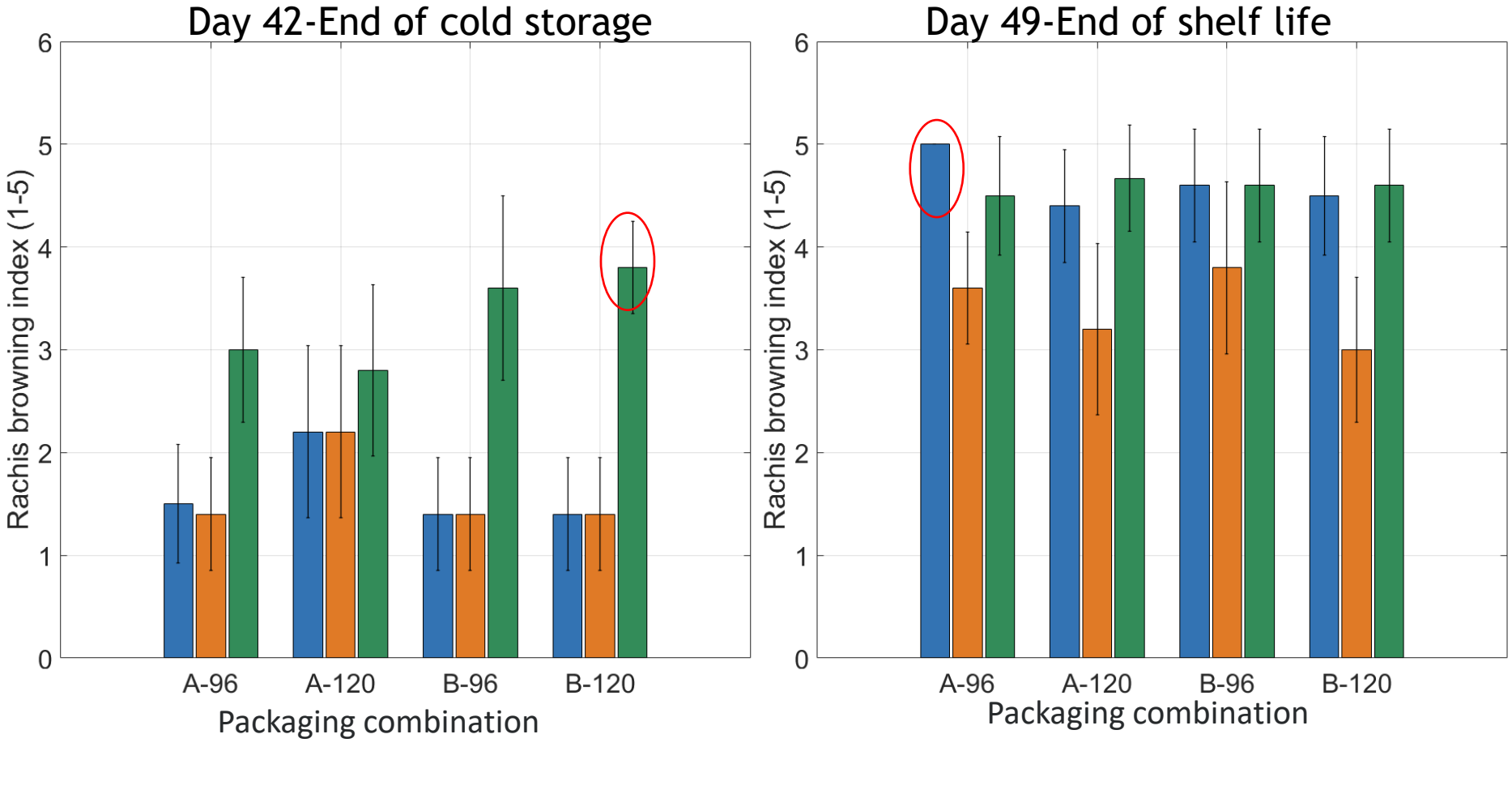
e) Moisture absorbance sheet

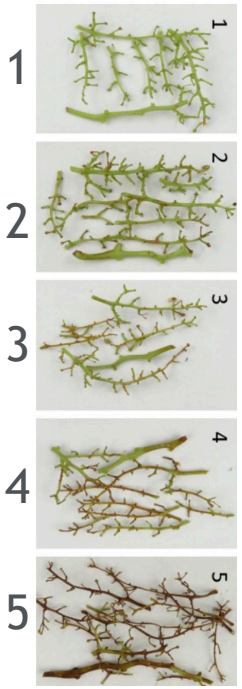
f) The liner is folded over the top of the fruit and sealed

Statistic analysis

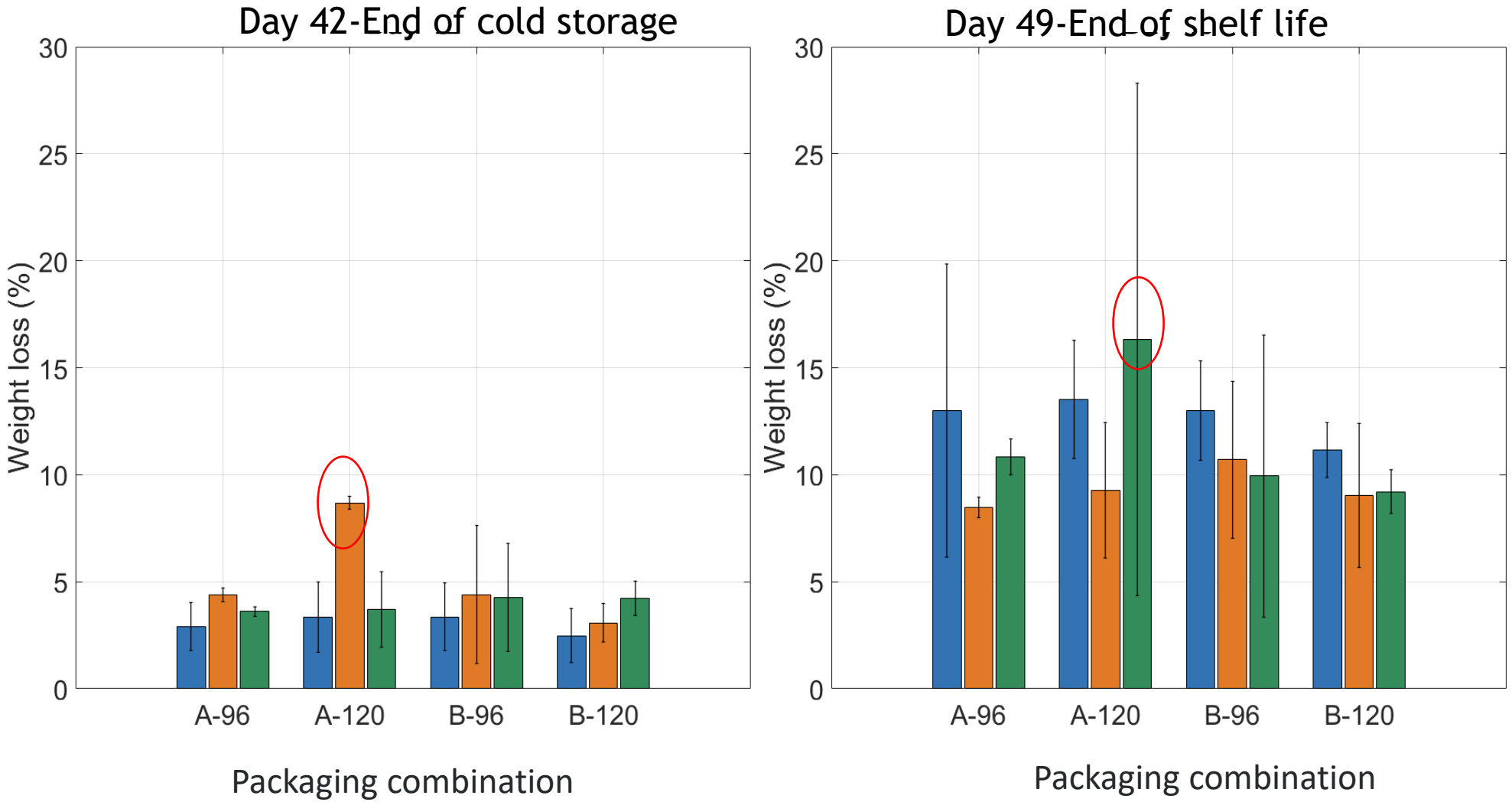
- Statistical software: Statistica (version XX; TIBCO Software Inc.) and MATLAB
- Analysis: Four-way factorial ANOVA
- Factors: Liner × Box × Treatment × Storage time
- Significance level: $p \leq 0.05$
- Post-hoc test: Tukey's Honestly Significant Difference (HSD)
- Graphs: Generated using Statistica and MATLAB
- Multivariate analysis was used for comparison

Results and discussion_ Rachis browning





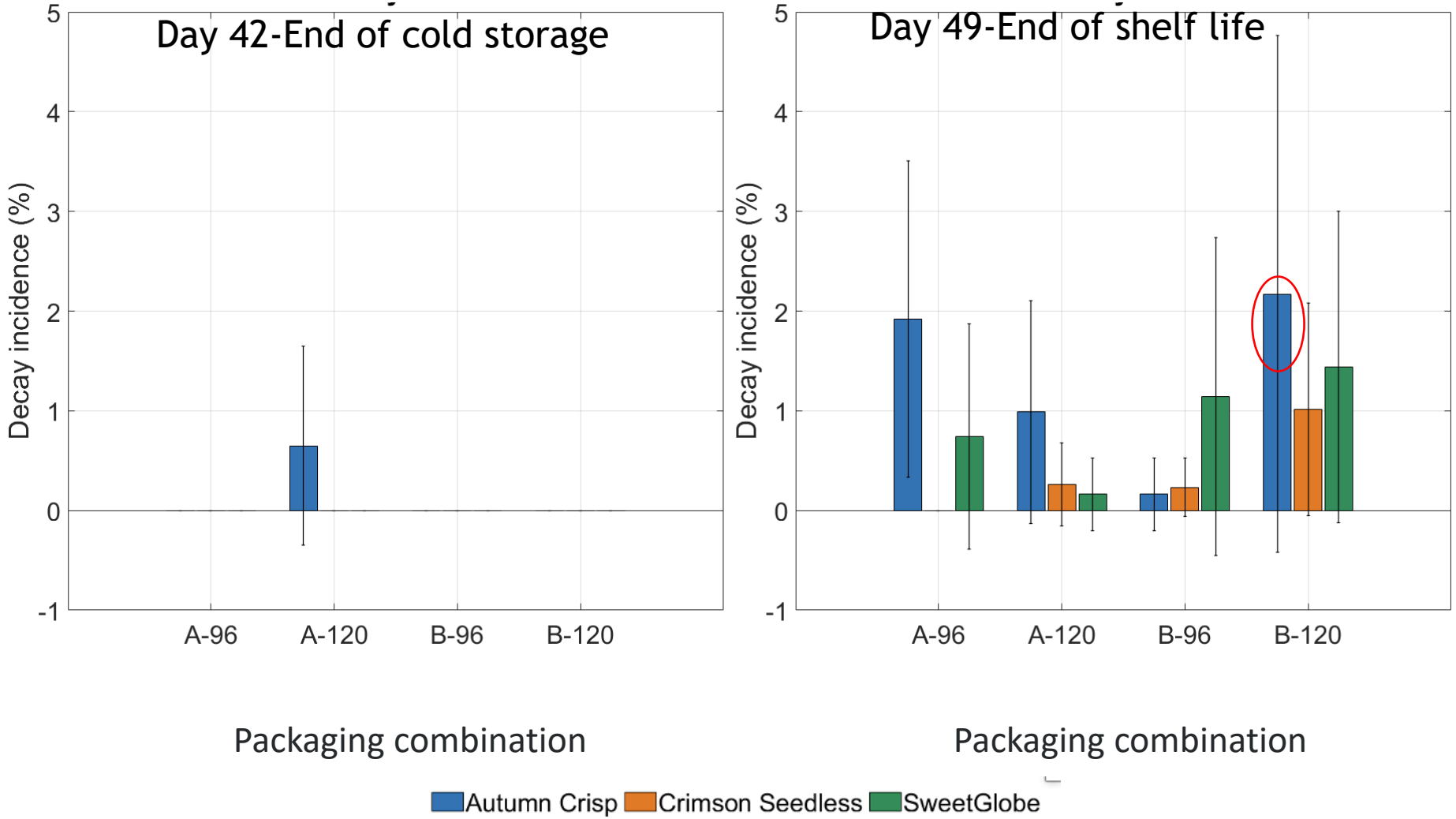
Weight loss (%)



42-End of cold storage

49-end of shelf life

Decay incidence (%)





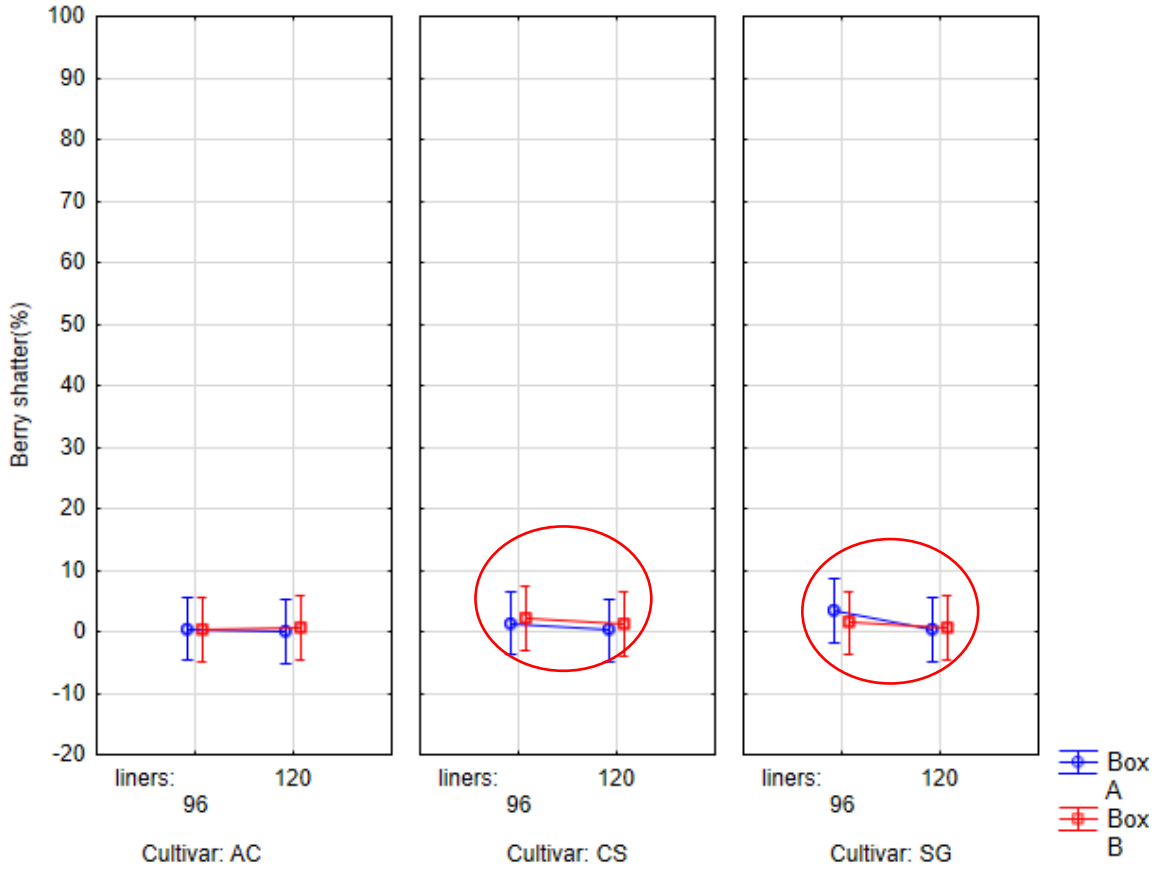
Decay-free grapes



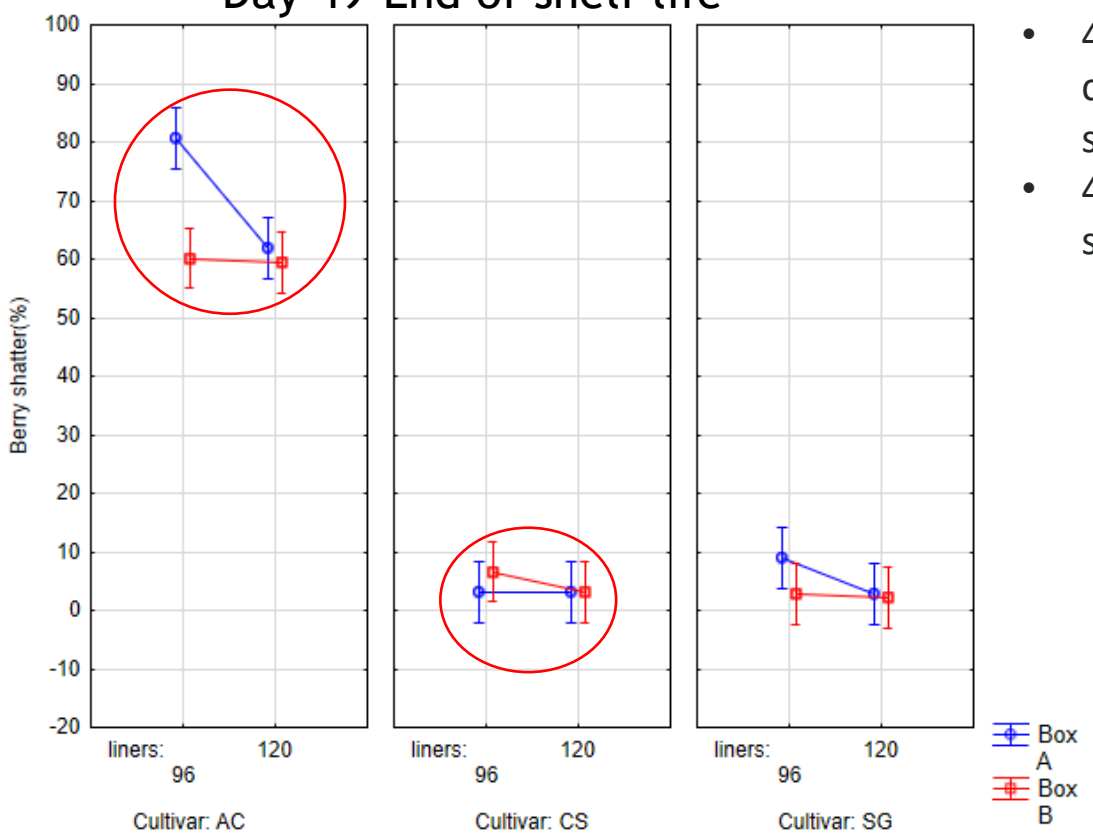
Grapes showing decay

Berry shatter (%)

Day 42-End of cold storage



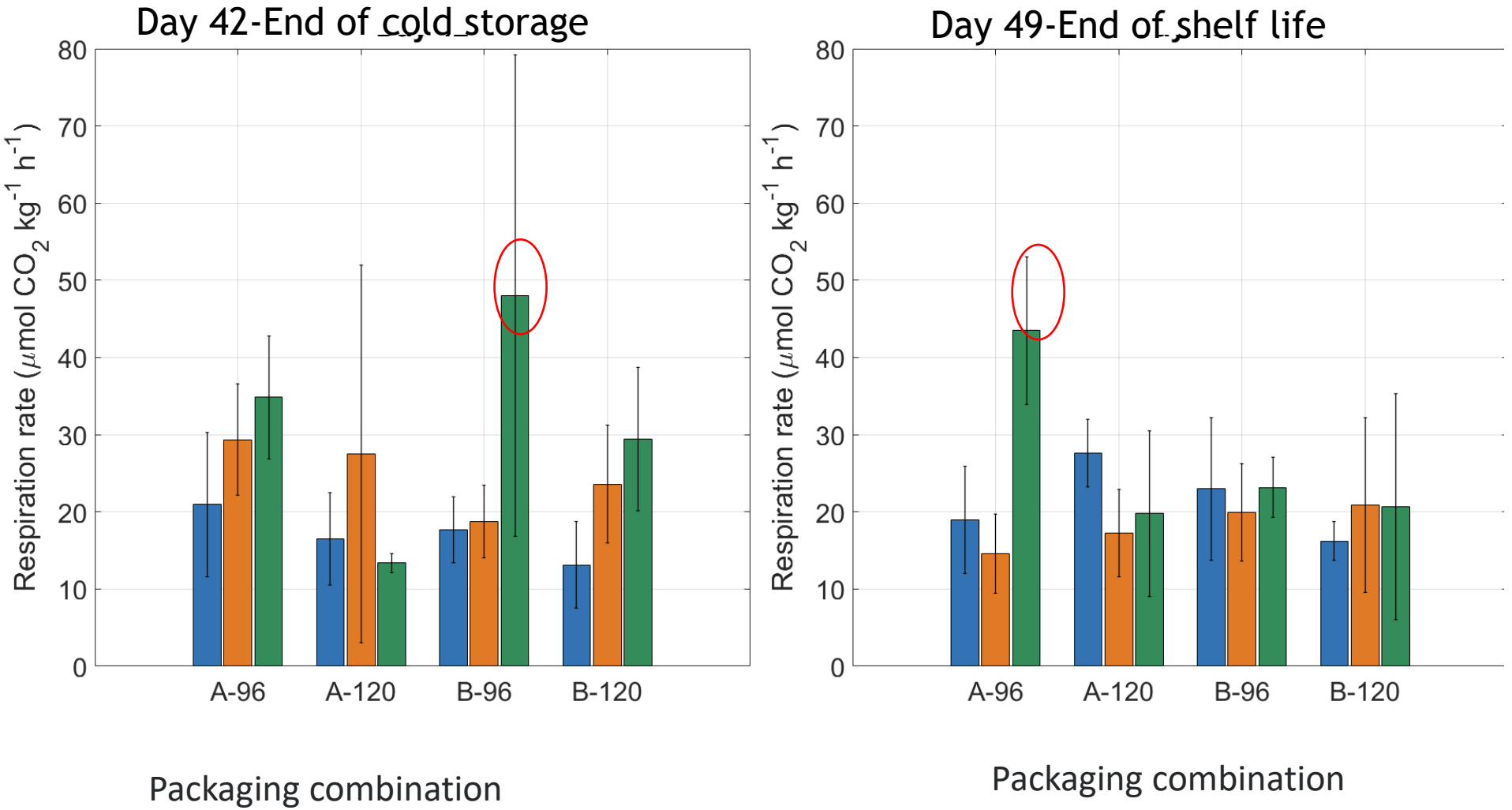
Day 49-End of shelf life



- 42-End of cold storage
- 49-end of shelf life

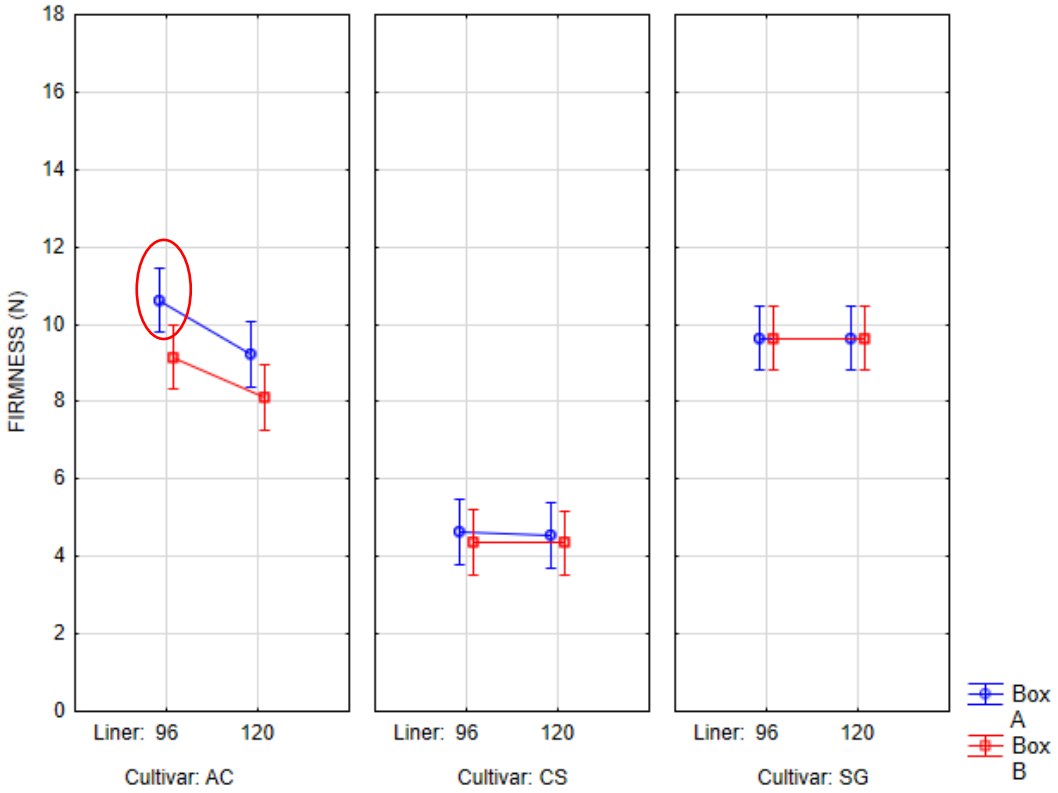
•AC – Autumn Crisp
•CS – Crimson Seedless
•SG – Sweet Globe

Respiration rate

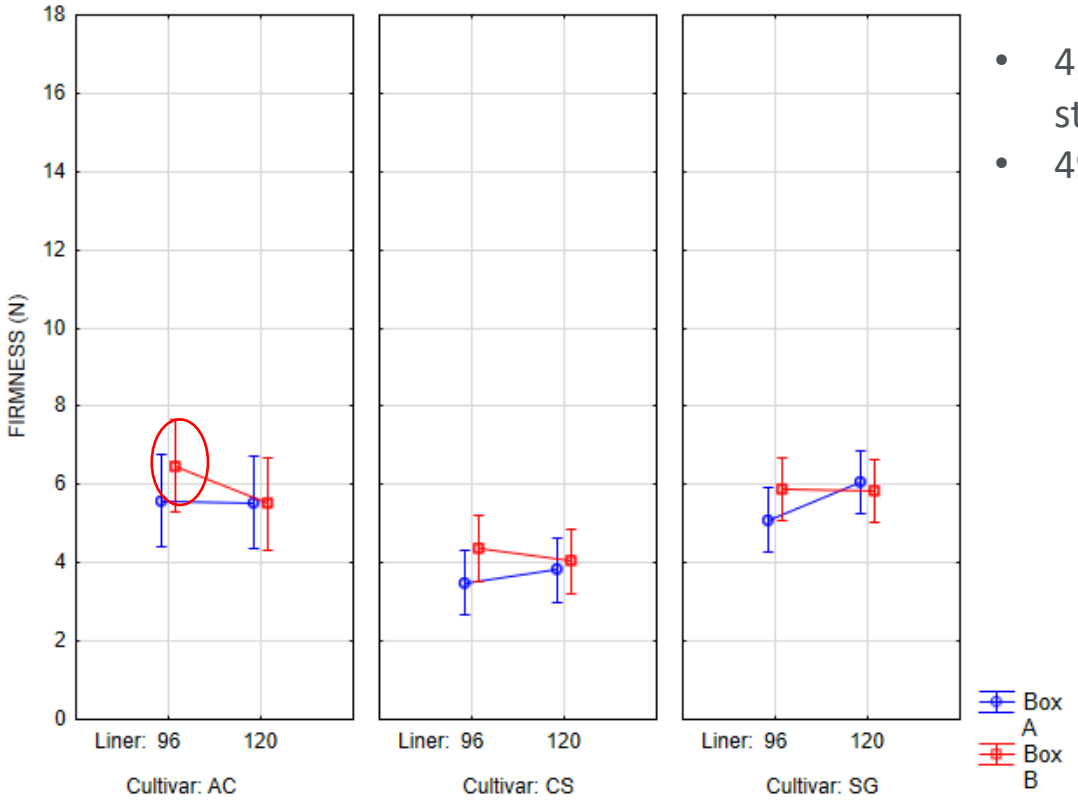


Firmness

Day 42-End of cold storage



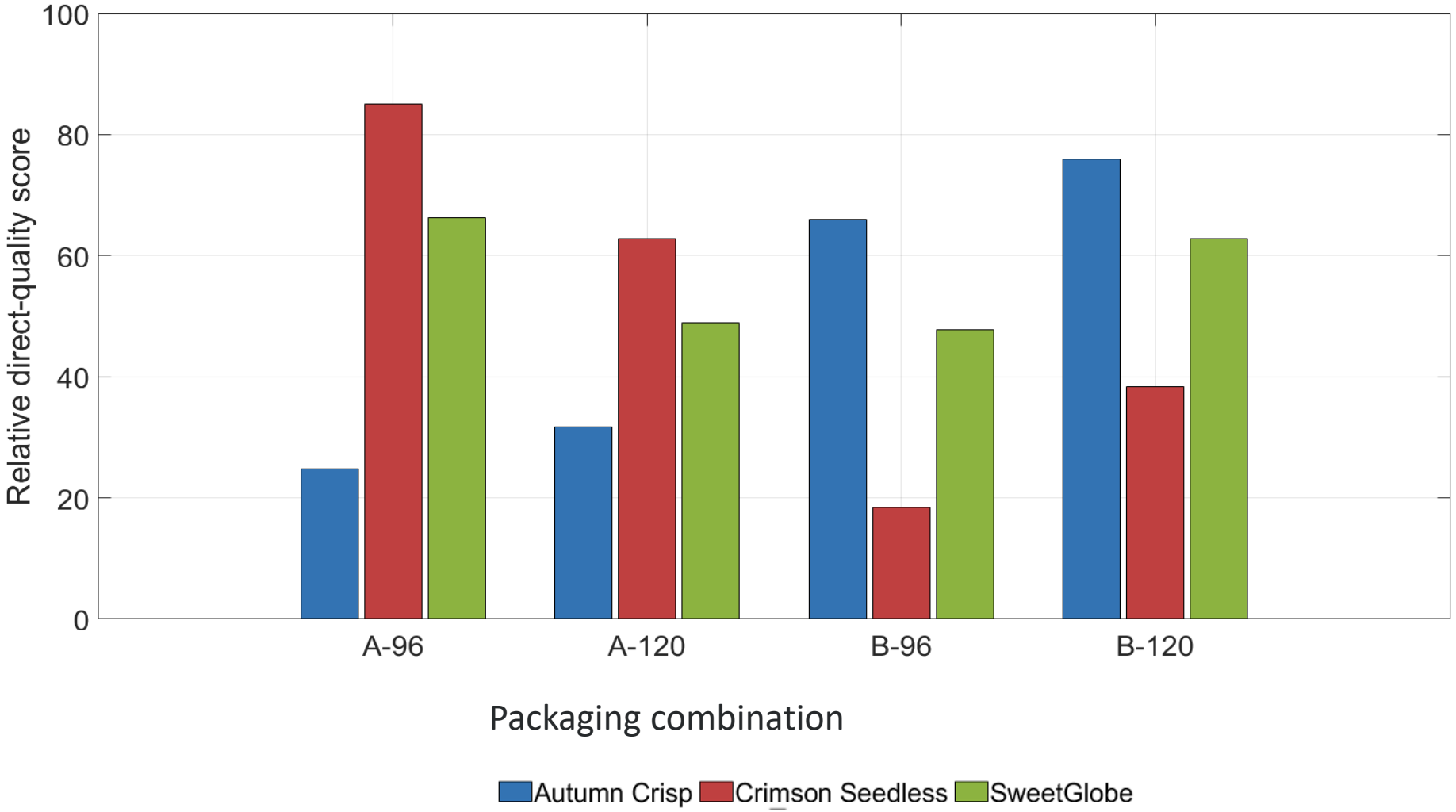
Day 49-End of shelf life



- 42-End of cold storage
- 49-end of shelf life

- AC – Autumn Crisp
- CS – Crimson Seedless
- SG – Sweet Globe

Overall postharvest quality ranking across packaging treatments



- These differences may reflect cultivar-specific physiological characteristics
- For example higher surface area-to-volume ratio can increase transpiration , moisture loss, and influencing postharvest quality

Recommendations

Cultivar	Packaging configuration
Crimson Seedless	Box A + Liner 96
Autumn Crisp	Box B + Liner 120
SweetGlobe	Either combination (Box A + Liner 96 or Box B + Liner 120)

Cultivar-specific packaging effects intensify toward end of shelf life

Note :As this is a preliminary study conducted over one season, the findings should be validated under additional seasons and commercial conditions before being widely applied in industry

Reference

- Lichter, A., Kaplunov, T., Zutahy, Y., Daus, A., Alchanatis, V., Ostrovsky, V. and Lurie, S., 2011. Physical and visual properties of grape rachis as affected by water vapor pressure deficit. *Postharvest Biology and Technology*, *59*(1), pp.25-33.

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Thank you
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