

A photograph of an avocado tree with several green, bumpy avocados hanging from the branches. The leaves are dark green and glossy. The background is slightly blurred, showing more of the tree and some sky.

# **1-Methylcyclopropene and Waxing Influence the Ripening and Storage Life of Avocado Fruit**

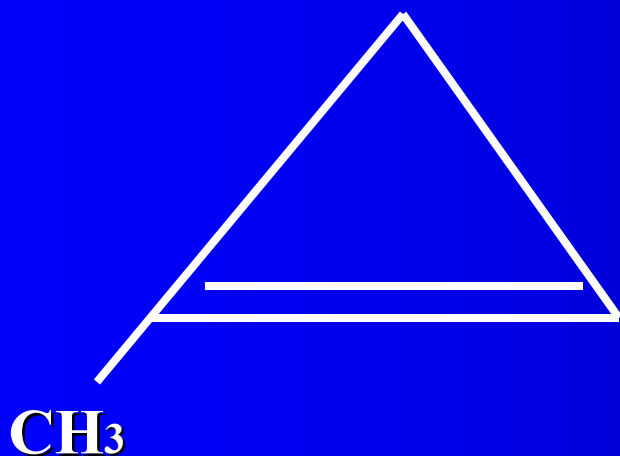
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# Postharvest Attributes of Avocado

- **Climacteric fruit**
  - Enhanced respiration and ethylene evolution
- **Ripening**
  - Only after harvest, 3 to 7 days, 15.5 to 24 °C
- **Lowest storage temperature**
  - **West Indian race and their hybrids**
    - cold sensitive, can be stored at 13 °C
  - **Mexican race**
    - cold tolerant, can be stored at 4.4 °C
  - **Guatemalan race**
    - Intermediate cold tolerant, can be stored at 7.2 °C

# 1-methylcyclopropene (1-MCP)



- Gaseous ethylene-action inhibitor
- Binds 'irreversibly' to the ethylene receptor
- Delayed ripening of tomato, banana, plum, apple, and other fruits and vegetables

# Previous Results

- 🥑 1-MCP resulted in extension of avocado storage life to at least 3 weeks
- 🥑 1-MCP treatment prior to storage delayed climacteric ethylene production and respiration
- 🥑 MCP treatment of early climacteric fruit was less effective at suppressing ripening
- 🥑 MCP-treated avocado fruit softened slowly but significantly

(Jeong et al.)

# Objective

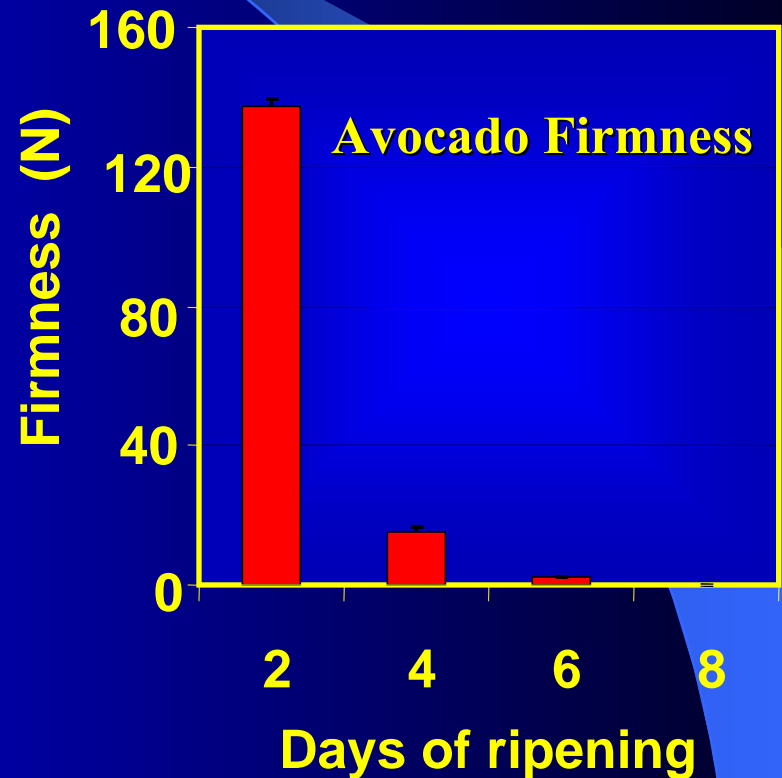
- ✓ Determine how to utilize 1-MCP and wax to delay ripening for extended shelf-life and quality maintenance

# Materials and Methods

- **Avocado fruit**
  - **cv. Tower II and Booth7**
    - **West Indian / Guatemalan hybrids (cold sensitive)**
  - **Harvested in South Florida, Homestead**
- **1-MCP treatment**
  - **EthylBlock® powder used as a source of 1-MCP gas**
- **Wax treatment**
  - **Fruit were dipped in wax (Sta-Fresh 819F®, FMC co.) for 1 min and dried**

# Measurements

- **FRUIT FIRMNESS (Newtons)**
  - Instron Universal Testing Instrument
- **PEEL COLOR (L\*, chroma, hue angle)**
  - Minolta Chroma Meter
- **ETHYLENE (C<sub>2</sub>H<sub>4</sub>)**
  - GC (HP Model 5860)
  - expressed as  $\mu\text{l C}_2\text{H}_4 \text{ kg}^{-1} \text{ h}^{-1}$
- **RESPIRATION (CO<sub>2</sub>)**
  - GC (GowMac Model 580)
  - expressed as  $\text{mg CO}_2 \text{ kg}^{-1} \text{ h}^{-1}$



# Measurements

- **Analysis of Polygalacturonase, Pectin methylesterase, C<sub>x</sub>-cellulase,  $\alpha$ - and  $\beta$ -galactosidase**
  - **Prepare cell-free protein extracts**
  - **Enzyme assays**
    - **PME - spectrophotometric assay**
    - **PG - reductometric**
    - **CX - viscometric**
    - **$\alpha$ - and  $\beta$ - Gal – nitrophenylglycoside hydrolysis**



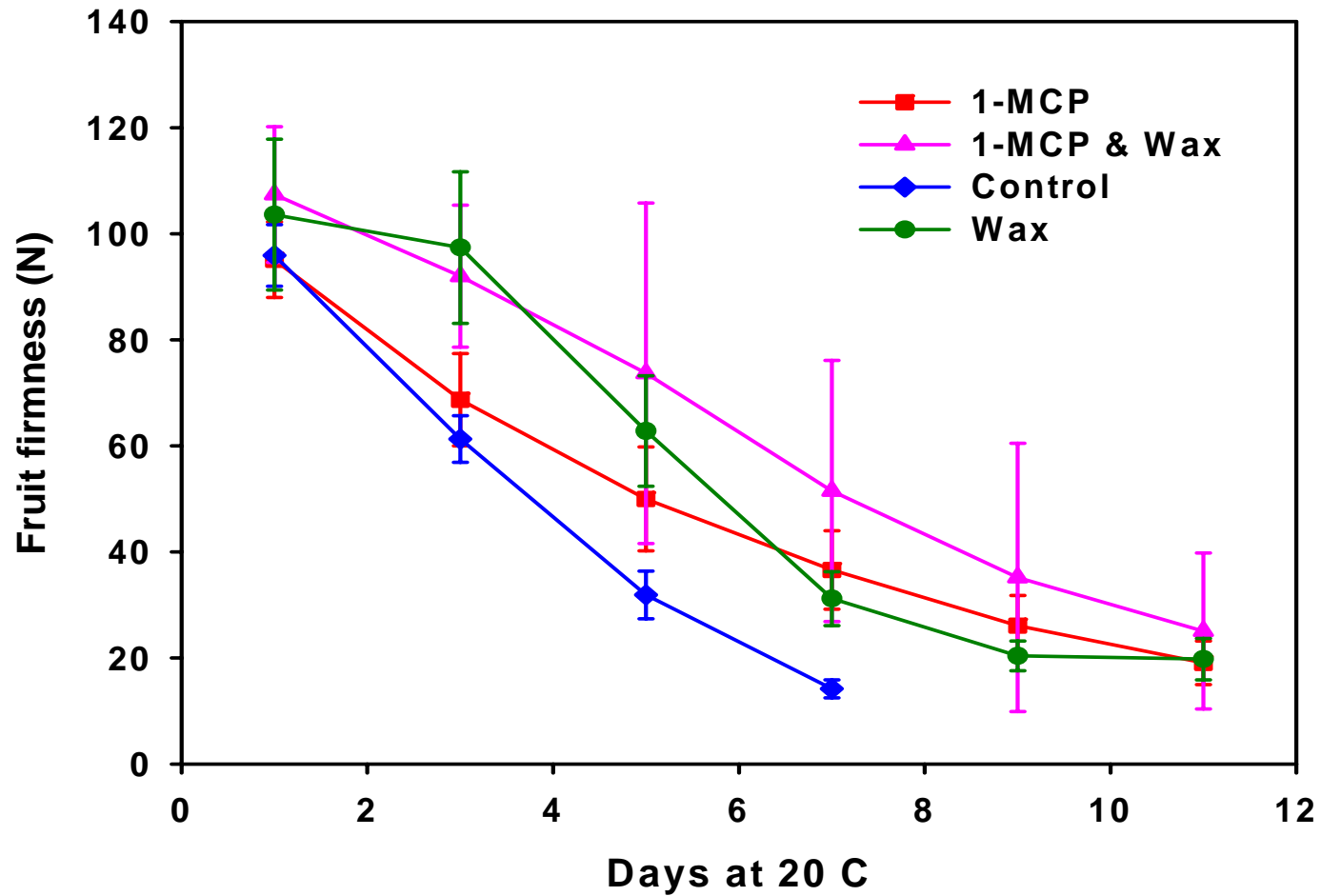
# **Data analysis**

- **Completely Randomized Design**
- **All data subjected to analysis of variance**
- **Means were separated using Duncan's Multiple Range Test ( $P < 0.05$ )**

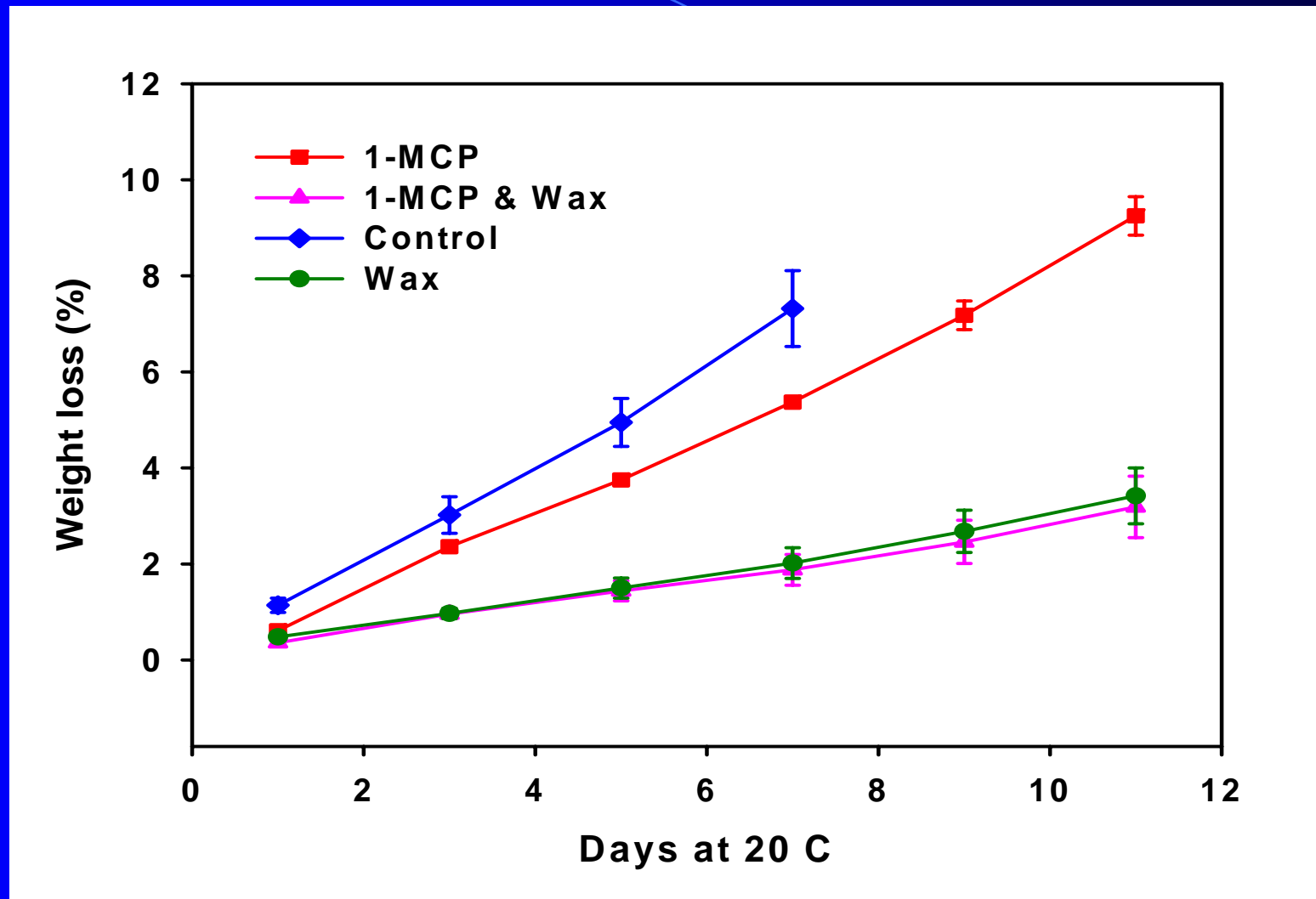
# Experiment 1

- **Treatment 1 (control): No wax, No MCP**
- **Treatment 2: Wax, No MCP**
- **Treatment 3: No wax, + MCP (900 ppb at 20 °C for 12 h)**
- **Treatment 4: Wax and MCP (900 ppb at 20 °C for 12 h)**
- **All fruit stored at 20 °C (85% RH) after different treatments**

## Fruit firmness (N) for 'Tower II' avocados stored at 20 °C (85% RH)



## Weight loss (%) for 'Tower II' avocados stored at 20 °C (85% RH)



**Days to peak of C<sub>2</sub>H<sub>4</sub> and CO<sub>2</sub> production for 'Tower II' avocados stored at 20 °C (85% RH)**

Treatments		Days to peak	
MCP (ppb / h)	Wax	C <sub>2</sub> H <sub>4</sub>	CO <sub>2</sub>
900 / 12	No	7.7	10
900 / 12	Yes	6.3	9.5
0	No	4	6.5
0	Yes	4.5	6



**Control  
(6 days at 20 °C)**



**Wax  
(6 days at 20 °C)**



**MCP w/o wax  
(6 days at 20 °C)**



**MCP w/ wax  
(6 days at 20 °C)**



**‘Tower II’ : No wax, +MCP  
12 h 1-MCP (900 ppb) at 20 °C & 10 days at 20 °C**

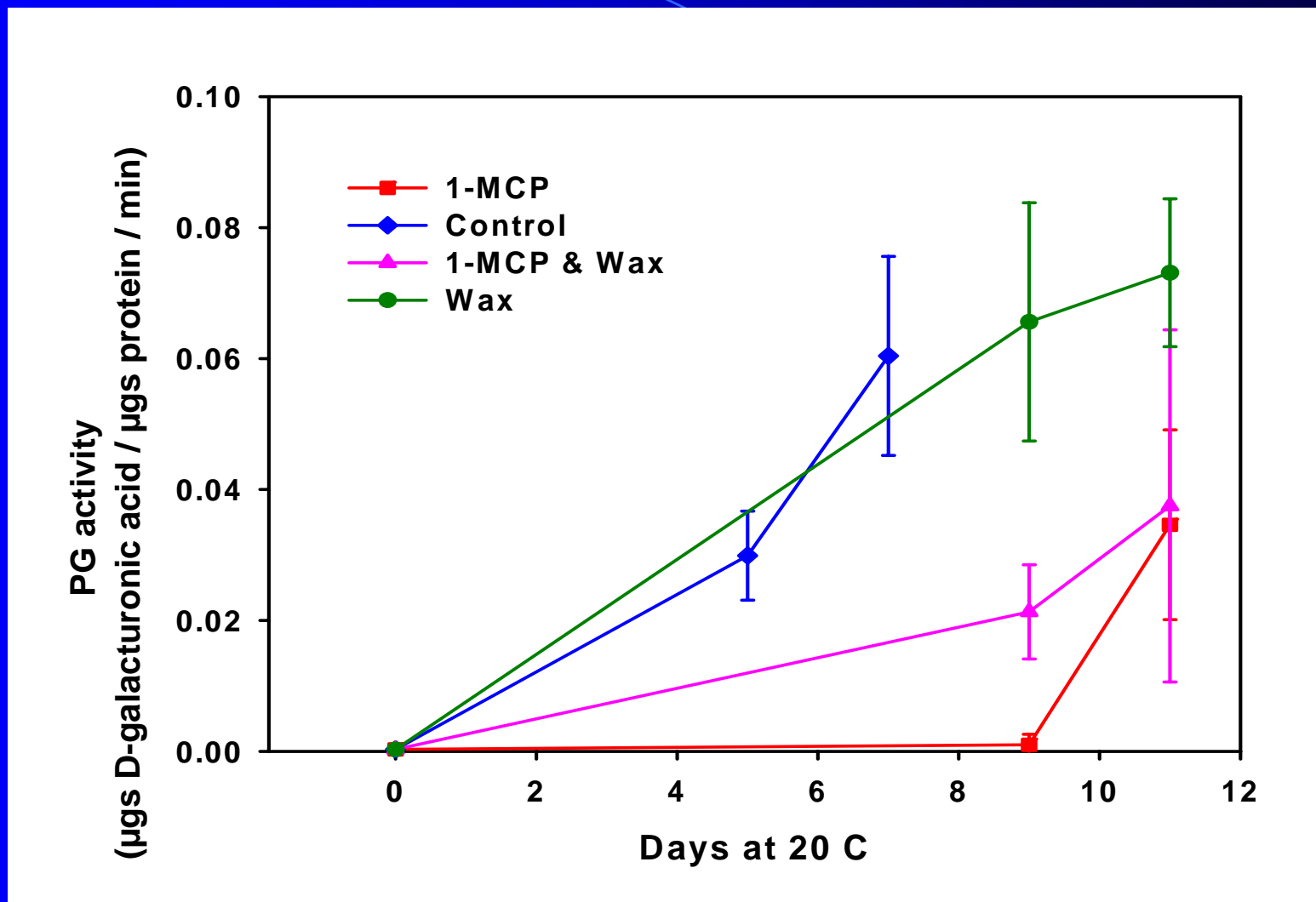


**‘Tower II’ : Wax, No MCP**

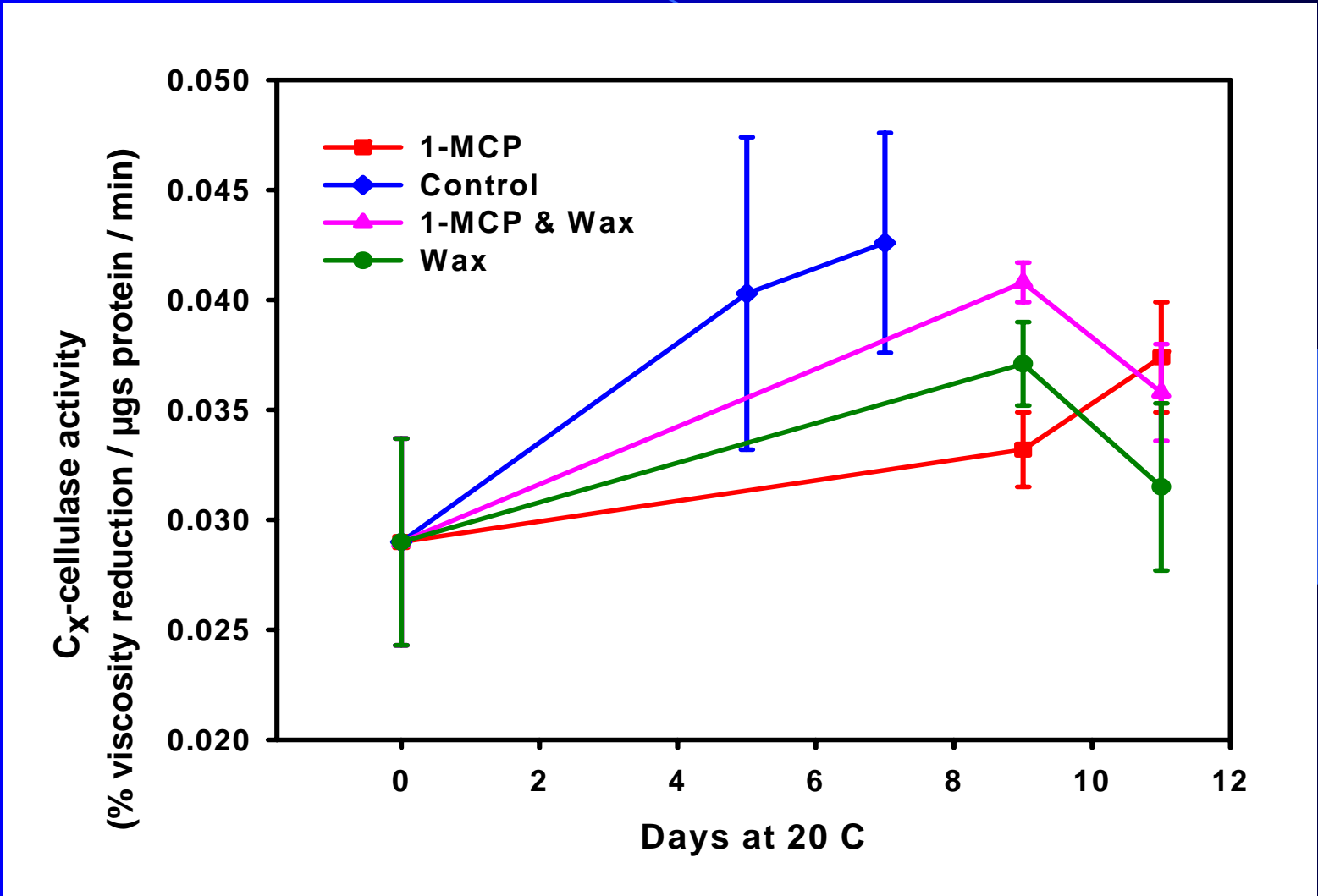
**11 days at 20 °C**



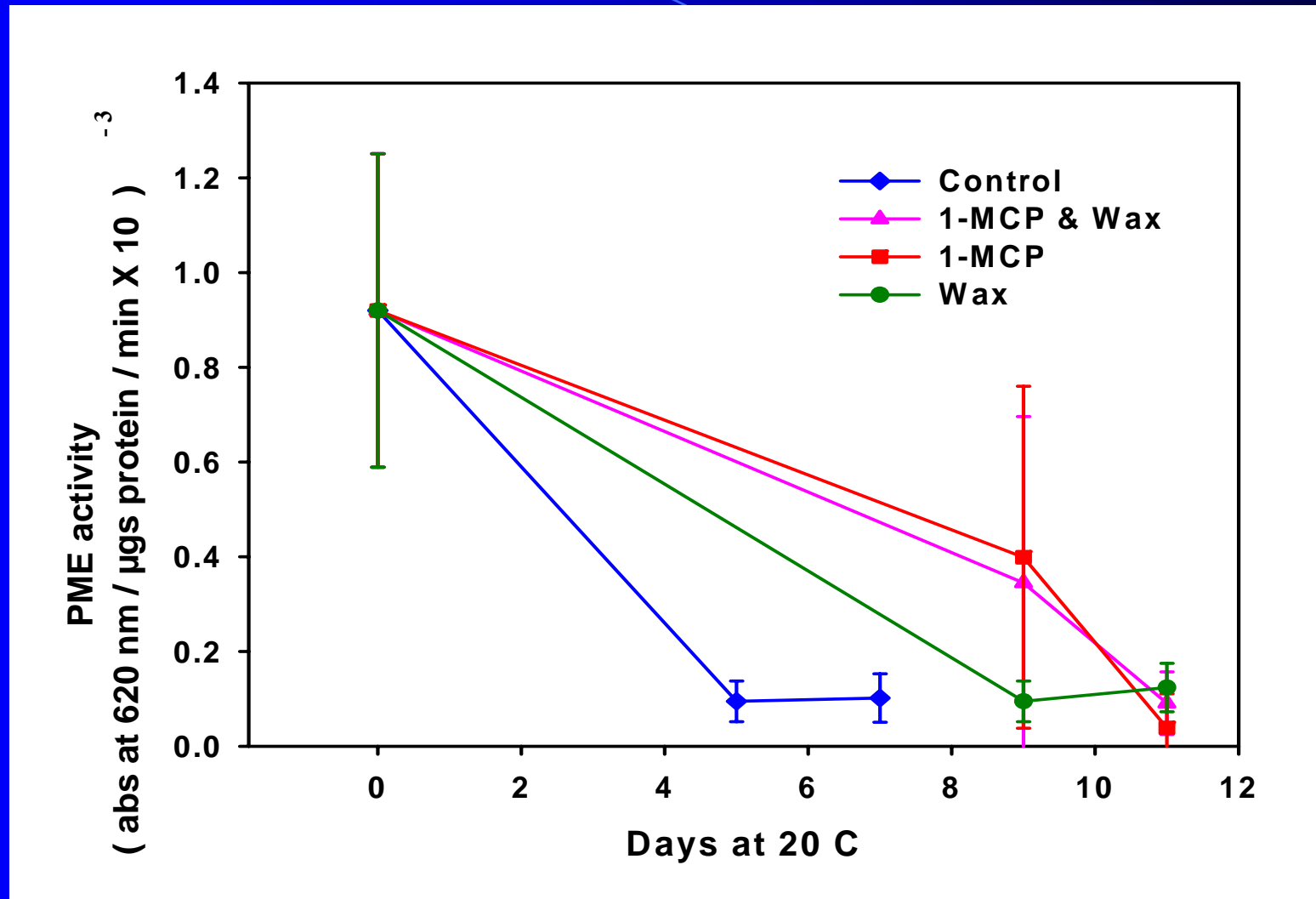
## PG activity for 'Tower II' avocados stored at 20 °C (85% RH)



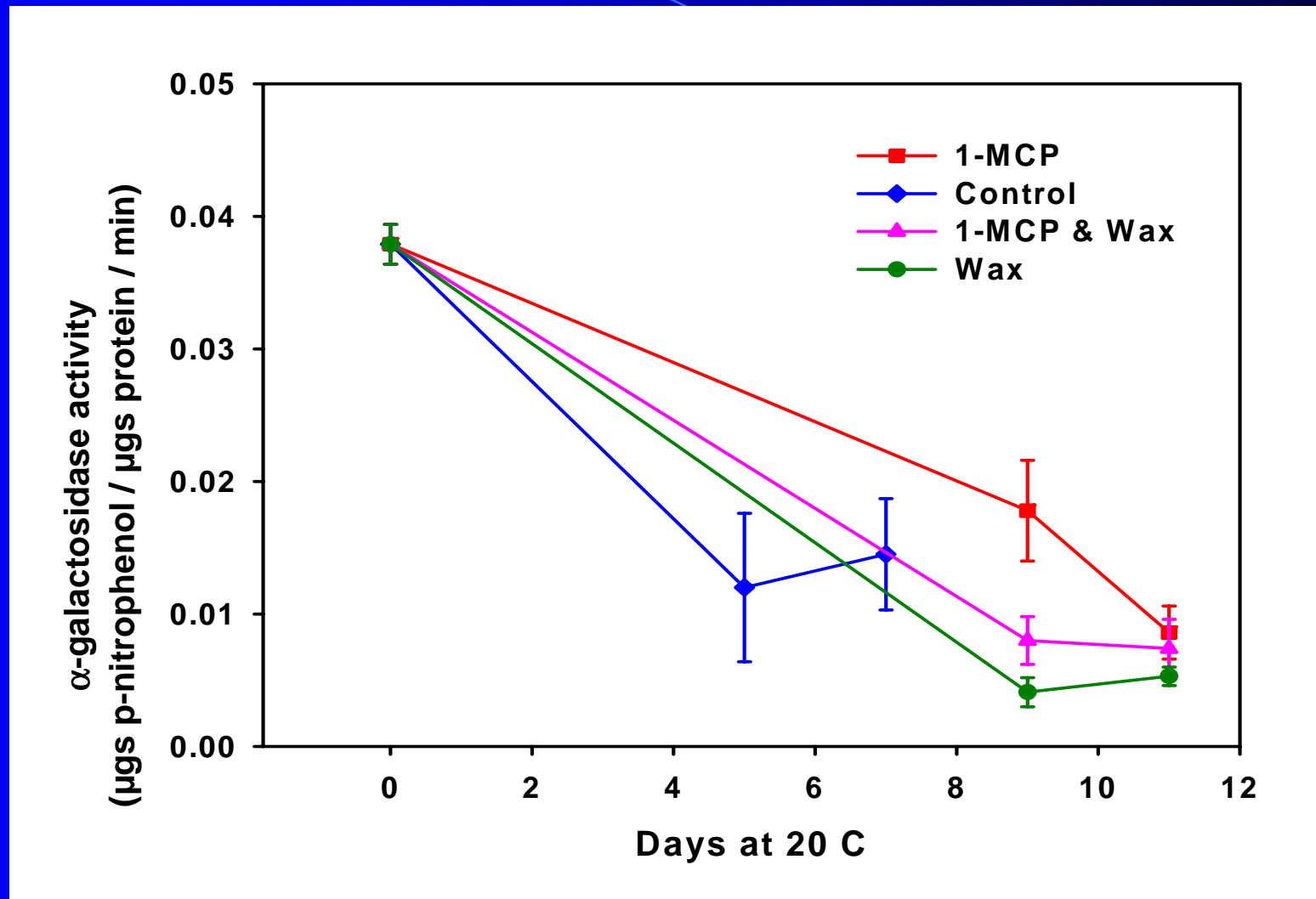
# C<sub>x</sub>-cellulase activity for 'Tower II' avocados stored at 20 °C (85% RH)



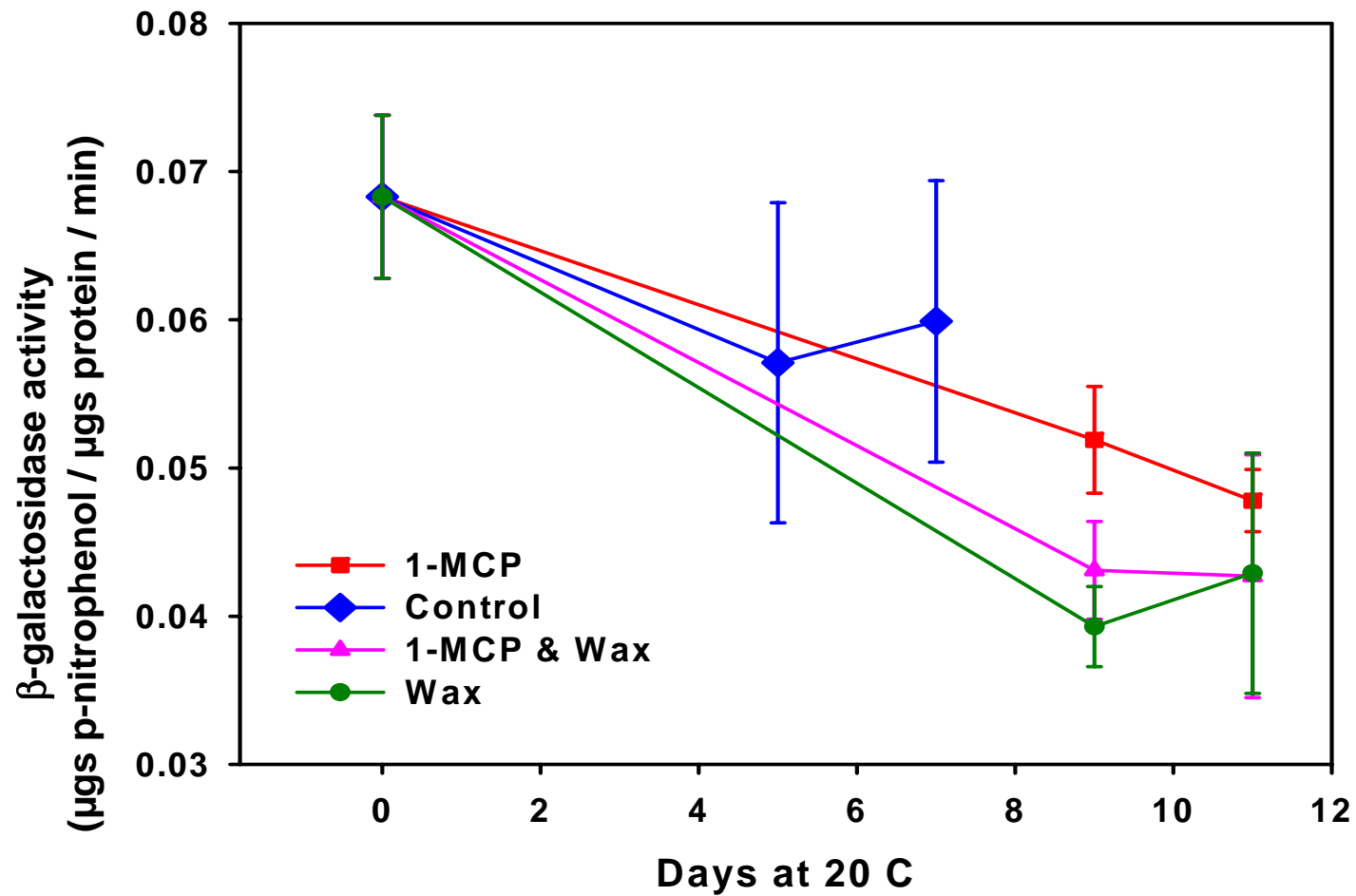
## PME activity for 'Tower II' avocados stored at 20 °C (85% RH)



## $\alpha$ -gal activity for 'Tower II' avocados stored at 20 °C (85% RH)



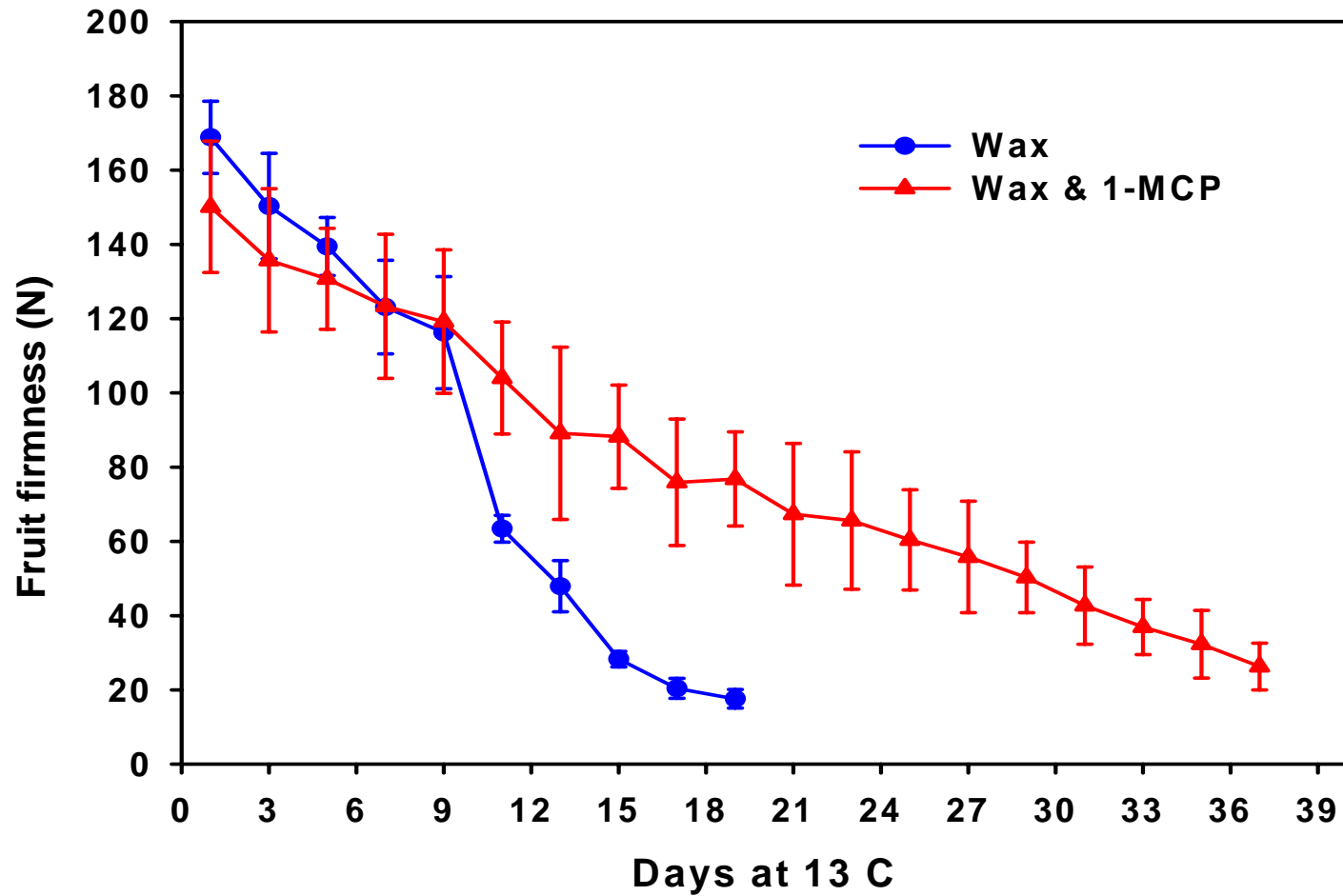
# $\beta$ -gal activity for 'Tower II' avocados stored at 20 °C (85% RH)



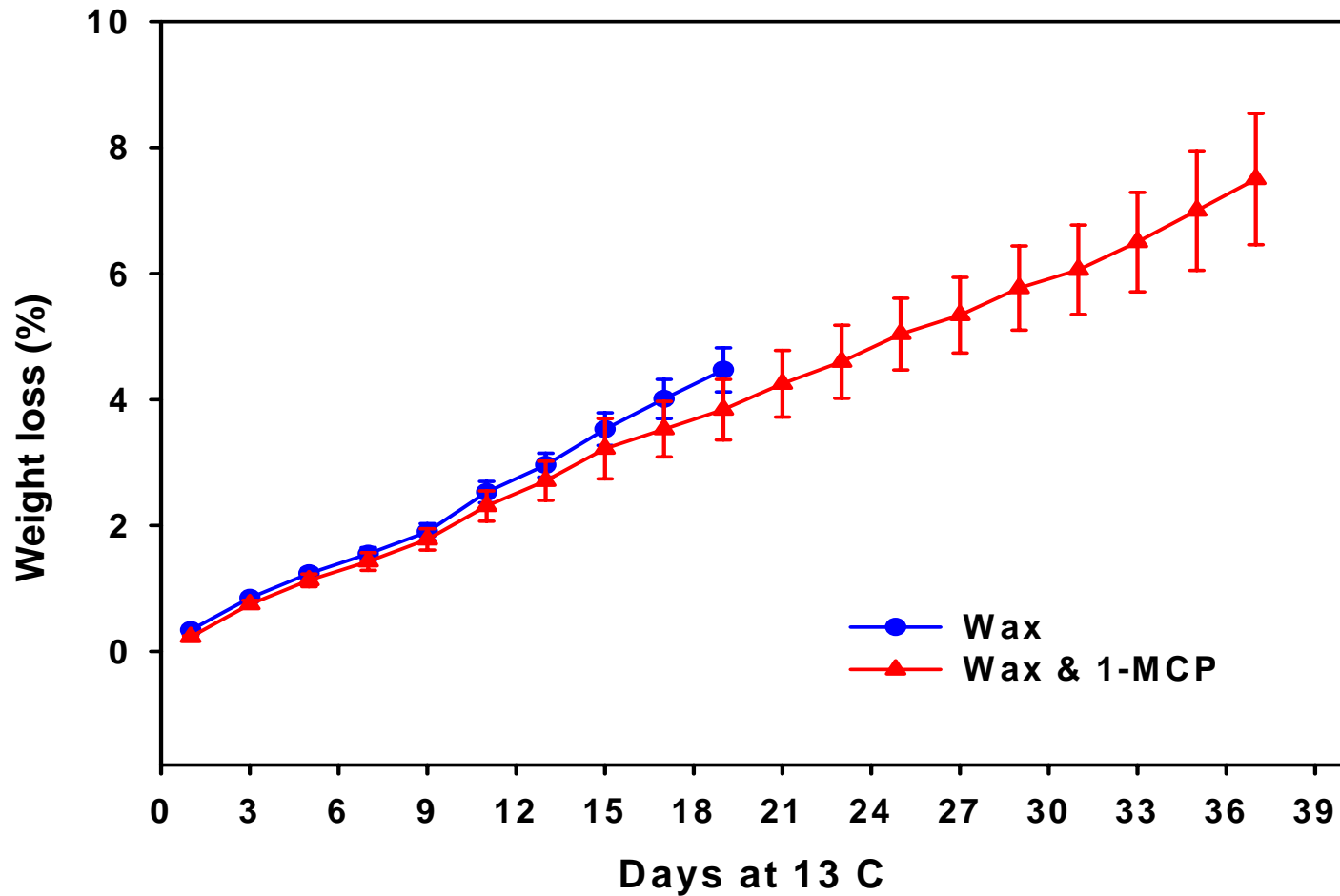
# Experiment 2

- **Treatment 1 (control): Wax, No 1-MCP**
- **Treatment 2: Wax and 1-MCP (900 ppb at 20 °C for 12 h)**
- **All fruit stored at 13 °C (85% RH) after different treatments**

## Firmness (N) for 'Booth 7' avocados stored at 13 °C (85% RH)

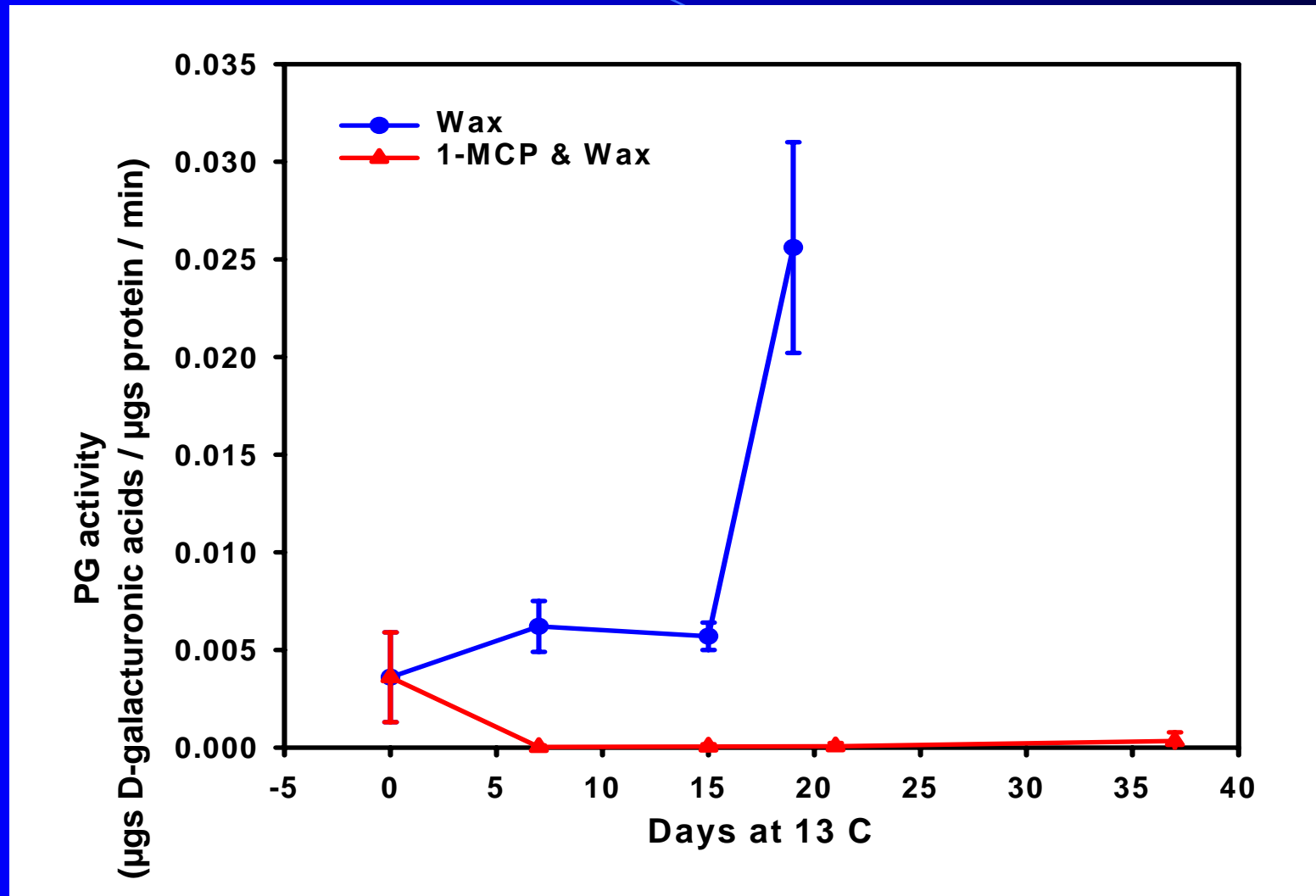


## Weight loss (%) for 'Booth 7' avocados stored at 13 °C (85% RH)





## PG activity for 'Booth 7' avocados stored at 13 °C (85% RH)



# Conclusions

- 🥑 1-MCP and wax applied separately or in combination significantly delayed avocado ripening
- 🥑 Fruit treated with both 1-MCP and wax had better retention of green color and firmness
- 🥑 1-MCP delayed climacteric ethylene evolution and respiration. Wax alone did not delay climacteric ethylene evolution and respiration
- 🥑 1-MCP significantly suppressed polygalacturonase accumulation but had less influence on other cell-wall enzymes

# **Current activity**

**Analysis of cell wall matrix polysaccharides (hemicellulose & pectins) to determine factors contributing to ethylene-independent softening in MCP-treated fruit**