

Title Delayed controlled atmosphere storage affects storage disorders of 'Empire' apples
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Abstract

The objective of this study was to investigate the effect of delayed controlled atmosphere (CA) storage on the development of storage disorders in 'Empire' apples, in combination with postharvest 1-methylcyclopropene (1-MCP) treatment, to maintain fruit firmness during long-term storage. Over two consecutive seasons, 'Empire' fruit were cooled overnight and then treated with or without 1 $\mu\text{L L}^{-1}$ 1-MCP for 24 h at 3 °C. Apples were subsequently held either in CA storage (2.5 kPa O₂ + 2.0 kPa CO₂) at 3 °C for 9 months or in ambient air at 1 °C for 1 or 2 months and then CA storage at 3 °C for 8 or 7 months (delayed CA), respectively. 1-MCP-treated apples with a 2-month delay in CA establishment had less external CO₂ injury and flesh browning during both years of study. Delayed CA for 1 month also reduced external CO₂ injury incidence, similar to the 2-month delay. Delayed CA did not affect core browning incidence in 1-MCP-treated fruit, although a 2-month delay in CA reduced core browning in apples without 1-MCP. 1-MCP improved firmness retention of 'Empire' apples during long-term CA storage, even when CA establishment was delayed. Fruit not treated with 1-MCP were always softer with delayed CA storage. There was little effect of delayed CA on internal ethylene, soluble solids, or titratable acidity. Overall, the results suggest that delaying CA storage to reduce the development of certain storage disorders in 'Empire' apples could be utilized in combination with 1-MCP treatment to retard fruit softening during long-term storage. This may be an acceptable compromise for reducing fruit losses due to storage disorders while maintaining acceptable firmness for the marketplace.