

Title Cold pre-treatment is effective for 1-MCP efficacy in ‘Tsugaru’ apple fruit
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Abstract

1-Methylcyclopropene (1-MCP) treatment maintains apple fruit quality during storage, but its efficacy is dependent on a number of conditions. ‘Tsugaru’ apples are a major early season cultivar in Japan, but because ‘Tsugaru’ fruit produce abundant ethylene, they have a short shelf-life, and efficacy of 1-MCP is not as high with ‘Tsugaru’ as with other cultivars. To improve 1-MCP efficacy, ‘Tsugaru’ fruit were pre-cooled at $-1\text{ }^{\circ}\text{C}$ or $-3\text{ }^{\circ}\text{C}$ for 24 h before 1-MCP treatment. Ethylene production decreased with the cold treatment, resulting in better storage after 1-MCP treatment. Although ethylene production was low at the end of 24 h of the cold pre-treatment, expression of *ACSI*, the ethylene receptor genes *ERS1*, *ETR1(a)*, *ETR1b*, *ETR2* and *ETR5*, and the cell wall degradation-related gene *PGI* all increased with a 24 h cold treatment. It is assumed that these elevated gene expression levels were not caused by ethylene, but more directly by cold stimulus. Thus, a short period of cold stimulus suppresses ethylene production, but induces expression of some genes. 1-MCP treatment was more effective with some initial fruit chilling.