Title Delay of tomato fruit ripening in response to 1-methylcyclopropene is influenced by internal ethylene levels

Author Zhengke Zhang, Donald J. Huber , Brandon M. Hurr and Jingping Rao

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Abstract

Using tomato fruit as a model system, this study tested the idea that internal ethylene levels can modulate the efficacy of 1-MCP at suppressing ripening in climacteric fruits. In the first experiment, breaker-turning stage tomato (cv. Sebring) fruit were treated with gaseous 1-MCP (SmartFresh^{SM} Quality System) under conditions (21.7 μmol m^{-3}, 516 nL L^{-1}) affording maximum inhibition of ripening, followed by subsequent exposure to 4.07 mmol m^{-3} (100 μL L^{-1}) ethylene for 3 or 6 h. Fruit softening and hue angle decline in 1-MCP-treated fruit were minimally affected in response to ethylene, consistent with strong binding of 1-MCP for ethylene receptors. In contrast to sequential 1-MCP and ethylene treatments, simultaneous treatment of breaker-turning 'Sebring' tomato fruit with 100 μL L^{-1} ethylene and gaseous 1-MCP completely negated the capacity of 1-MCP to inhibit fruit softening and hue angle decline. When breaker-turning fruit were treated with 100 μL L^{-1} ethylene for 6 h followed by exposure to aqueous 1-MCP (3.70 mmol m^{-3}, 200 μg L^{-1}) at levels eliciting maximum inhibition of tomato ripening, sensitivity to 1-MCP was significantly reduced in the short-term (0–1 h) and recovered within 6 h to patterns characteristic of fruit receiving 3.70 mmol m^{-3} aqueous 1-MCP without prior exposure to ethylene. Re-sensitization was reflected in patterns of softening, climacteric ethylene and respiratory responses, hue angle decline, lycopene content and titratable acidity changes. The time required for re-sensitization to 1-MCP paralleled the time required for return of internal ethylene levels to concentrations present prior to ethylene treatment. We propose that internal ethylene levels may contribute to the divergent sensitivities of some climacteric fruits to 1-MCP applied after initiation of ripening.