RESPONSES OF MCP-TREATED FUJI AND BRAEBURN APPLE FRUIT TO AIR AND CA STORAGE CONDITIONS

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Ethylene is a plant hormone that regulates climacteric fruit ripening. Ethylene gas diffuses from fruit cells and tissues and can affect other fruit. Low temperature and controlled atmospheres (CA) with low oxygen and high carbon dioxide reduce ethylene production and action, as well as slowing ripening and loss of optimum fruit quality. MCP (1-methylcyclopropene) is a new tool for the management of ethylene action/production by climacteric fruit including apple. This compound is an ethylene action inhibitor that prevents plant tissues from responding to ethylene by combining with ethylene receptors (Sisler and Blankenship, 1996; Sisler and Serek, 1997). MCP gas applied at harvest delays ripening, improves storage life and prevents superficial scald and other physiological disorders in many apple cultivars including Delicious, Granny Smith, Fuji and Gala (Fan et al., 1999a, Fan et al., 1999b). For many cultivars, treatment with MCP is most effective when fruit are harvested at CA maturity and MCP is applied soon after harvest.

Fuji and Braeburn apples fruit are susceptible to internal browning caused by exposure to high CO_2 during storage (Elgar, et al., 1998, Argenta et al., 2000). Factors contributing to development of CO_2 injury in these cultivars include maturity at harvest, watercore, CO_2 concentration in storage, and the duration between harvest and imposition of CA conditions. This study was conducted to evaluate the effects of MCP on quality and development of disorders in Fuji and Braeburn apples during cold storage in air or CA.

Fuji and Braeburn apples were harvested from commercial orchards in north central Washington at commercial maturity in October 1998. Fruit were treated with 1 ppm MCP for 24 hours at 68 ºF. Following MCP treatment, fruit were cooled to 33 ºF. Fruit were stored in air or CA with either:

- 2% O_2 + <0.05% CO_2,
- 0.25% O_2 + <0.05% CO_2, or
- 2% O_2 + 3% CO_2

for up to 6 months plus an additional 7 days ripening at 68 ºF. We used 0.25% O_2 or 3% CO_2 to increase the risk of developing injury but do not recommend these concentrations for commercial storage. Maturity and quality of individual apples were determined at harvest and after cold storage plus 7 days ripening.

MCP effectively reduced ethylene production and improved firmness and titratable acidity (TA) retention of Fuji and Braeburn apple fruit stored in air or CA.

After 6 months storage, MCP-treated Fuji and Braeburn apples stored in air had lower internal ethylene concentration than untreated fruit stored in CA. MCP-treated fruit stored in air had higher firmness and TA than control fruit stored in CA. For both apple cultivars, MCP and CA treatment effects on firmness and TA were greater after 6 months compared to 3 months

MCP treatment did not significantly affect the rate of watercore dissipation or development of internal browning (CO_2-injury) in Fuji apples. Dissipation of watercore was slower in CA- than in air-stored fruit. Fuji apples stored in 2%O_2 + 3%CO_2 developed internal browning while fruit stored in 0.25% O_2 + 0.05 %CO_2; 2% O_2 + 0.05% CO_2; or air did not. These results confirm previous studies indicating Fuji apples are susceptible to brown-heart (CO_2-injury) when stored in high CO_2 (>1%) atmospheres but tolerant to low O_2 storage conditions if CO_2 is held below 1%. The severity of CO_2 injury in Fuji apple did not increase from 3 to 6 months storage.

Severity of Braeburn browning disorder (BBD) was highest when fruit were stored in CA with 3% CO_2. Contrary to results with Fuji, Braeburn also developed BBD during air- and low CO_2 CA-storage. BBD has characteristics typical of a CO_2-related injury, such as brown-heart and cavity formation in the flesh (Elgar et al., 1998).

MCP treatment did not significantly affect development of BBD during the first 3 months of storage. However, apples treated with MCP had more severe BBD after long-term low CO_2 CA-storage compared with untreated fruit. This result indicates that MCP treatment may extend the period after harvest when fruit are susceptible to internal browning. Severity of BBD did not increase from 3 to 6 months storage except for MCP treated fruit stored in CA with low CO_2. Previous studies have indicated that internal browning in Fuji (Argenta et al., 2000) and Braeburn (Elgar et al., 1998) apples usually develops during the first 2 months after harvest.

Development of bitter pit in Braeburn fruit was not consistently affected by MCP treatment.

In conclusion, MCP treatment is as or more effective as CA storage for reducing ethylene production and preservation of firmness and acidity in Fuji and Braeburn during 3 or 6 months storage. However, MCP treatment does not reduce the risk of CO_2-induced internal browning.

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