

SmartFresh Application Timing After Harvest Affects Storability of McIntosh and Cortland Apples

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SmartFresh (1-methylcyclopropene) maintains firmness of McIntosh up to four months in regular air and seven months or longer in controlled atmosphere (CA) storage. However, effectiveness is reduced by high levels of internal ethylene that increase following harvest. As apples mature, they produce ethylene in larger amounts, and this stimulates ripening and reduces the effectiveness of SmartFresh. It is recommended that SmartFresh be applied to apples as soon as possible after harvest to avoid loss of efficacy. However, immediate application after harvest is not always possible when large CA rooms must first be filled with fruit, a process that can require several days to complete. The delays that occur in the normal process of filling a storage or application room may reduce effectiveness of SmartFresh.

Superficial scald is a skin browning disorder that occurs in apples stored longer than three to four months. SmartFresh can be used alone for preventing superficial scald in McIntosh, but most research has been based on applications within one day after harvest. For good control of scald, Cortland requires a drench with diphenylamine (DPA) or another antioxidant in addition to SmartFresh. Delays in application can also affect how well SmartFresh prevents scald.

This project was conducted to measure the effect of delayed application of Smart Fresh on firmness and superficial scald during CA storage in Cortland and McIntosh.

Materials & Methods

Fruit were harvested from McIntosh and Cortland orchards located at the Maine Agricultural Experiment Station in Monmouth. McIntosh were harvested September 16 and Cortland on September 23, 2004.

The trees were on semidwarfing rootstocks, M.7 and MM.111, and ranged in age from 20- to 30-years-old. One Cortland orchard was on B.9 rootstock and was five-years-old. Fruit were placed in cold storage immediately after harvest. At varying intervals after harvest, one, four, seven and ten days, fruit were removed from cold storage and treated with the labeled rate of SmartFresh, 1 ppm. An additional set of fruit was drenched with DPA. All fruit were placed in cold storage at 37°F after SmartFresh application. Controlled atmosphere conditions were established three to seven days following SmartFresh application.

Apples were removed from CA storage in January or late April and held in cold storage for two weeks. After removal from cold storage, fruit were kept at 64°F for one and seven days at which times firmness was measured on ten fruit from each orchard. Firmness of peeled flesh was measured on the green and red side of each fruit with an electronic firmness tester. In Jan., the occurrence of superficial scald was measured on ten fruit after seven days at 64°F. Superficial scald was measured on all remaining fruit (approximately 40 per orchard) in May.

Results & Discussion

The concentration of ethylene in the core cavity of the fruit before and during the harvest period can be used as an indication of when to harvest fruit for CA storage. High concentrations of ethylene occur as fruit ripen, and such fruit will not remain in good condition during storage. To measure ethylene, researchers use a specialized instrument, a gas chromatograph and apples that are representative of the orchard in terms of size and quality.

Levels of ethylene, starch index and firmness at

Table 1. McIntosh and Cortland maturity and firmness at harvest.

Variety	Starch index	Flesh firmness (lbs.)	Number of climacteric* fruit (% of total)
McIntosh	4.4	17.0	4
Cortland	1.5	18.6	6

* Climacteric apples are defined as having an ethylene concentration of 1 ppm or greater in the core cavity, and are less suitable for long term storage.

harvest indicated that both McIntosh and Cortland were in a suitable condition for long term storage (Table 1). Ethylene in McIntosh was undetectable at harvest and remained low in cold storage four days after harvest (Figure 1). Seven days after harvest, ethylene increased to a high level and continued to dramatically increase by ten days. Ethylene in Cortland apples was low at harvest and remained low after seven days of cold storage. By ten days, nearly every apple had a high level of ethylene. The increase in ethylene concentration occurred earlier in McIntosh and reached a higher concentration than in Cortland.

Firmness of untreated McIntosh fell from 17 lbs. at harvest to 11 lbs. after four months storage (Figure 2). SmartFresh applied one day after harvest

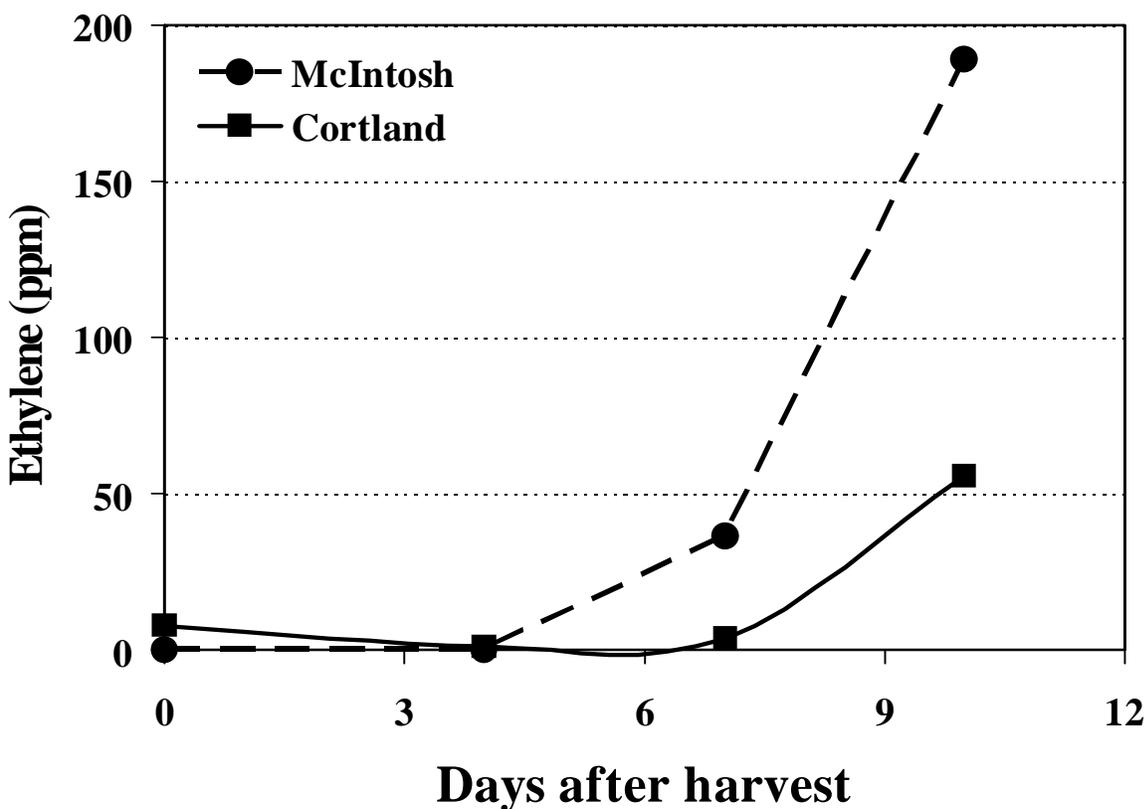


Figure 1. Internal ethylene concentration of McIntosh and Cortland apples following harvest and four, seven or ten days of cold storage.

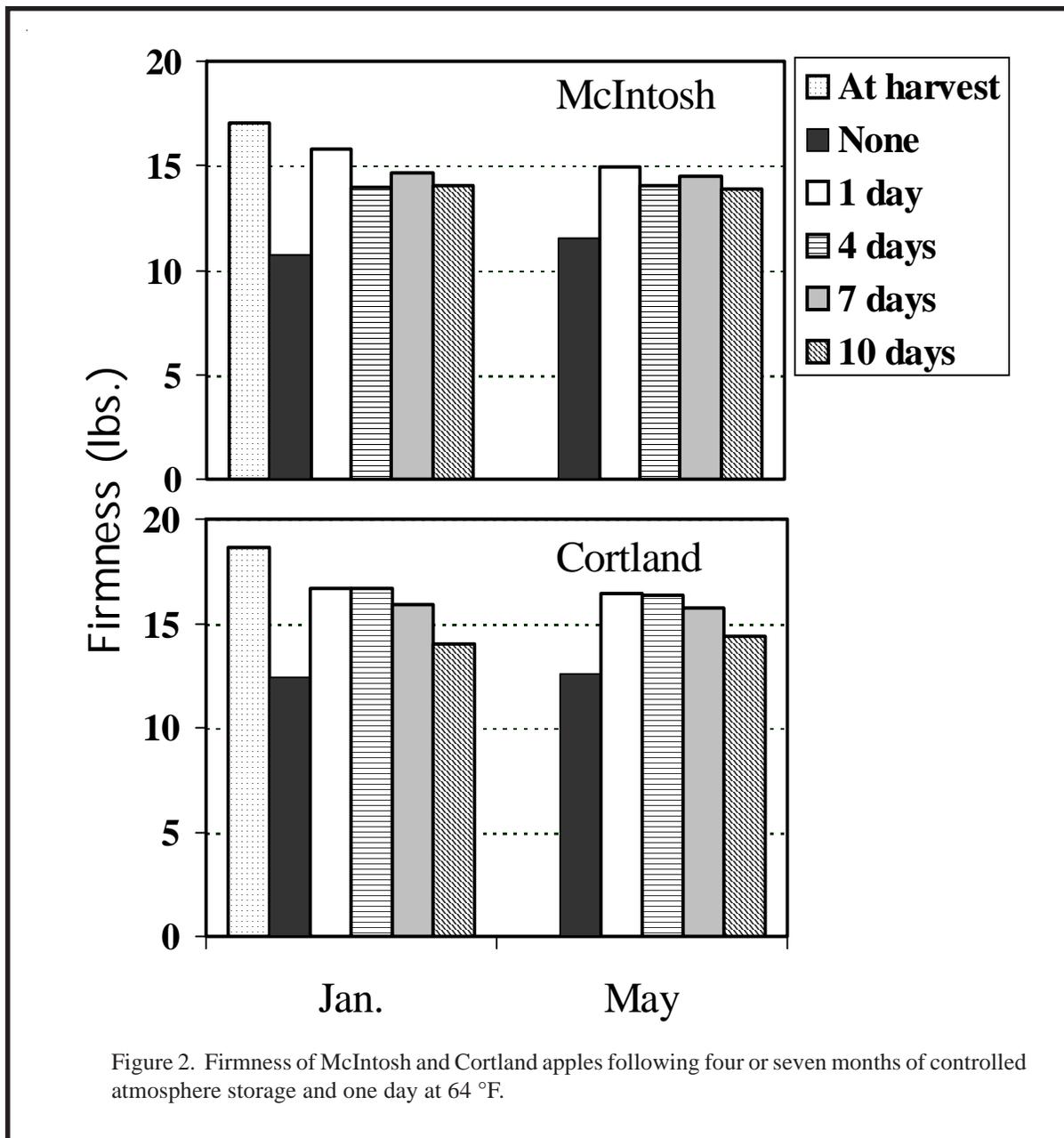


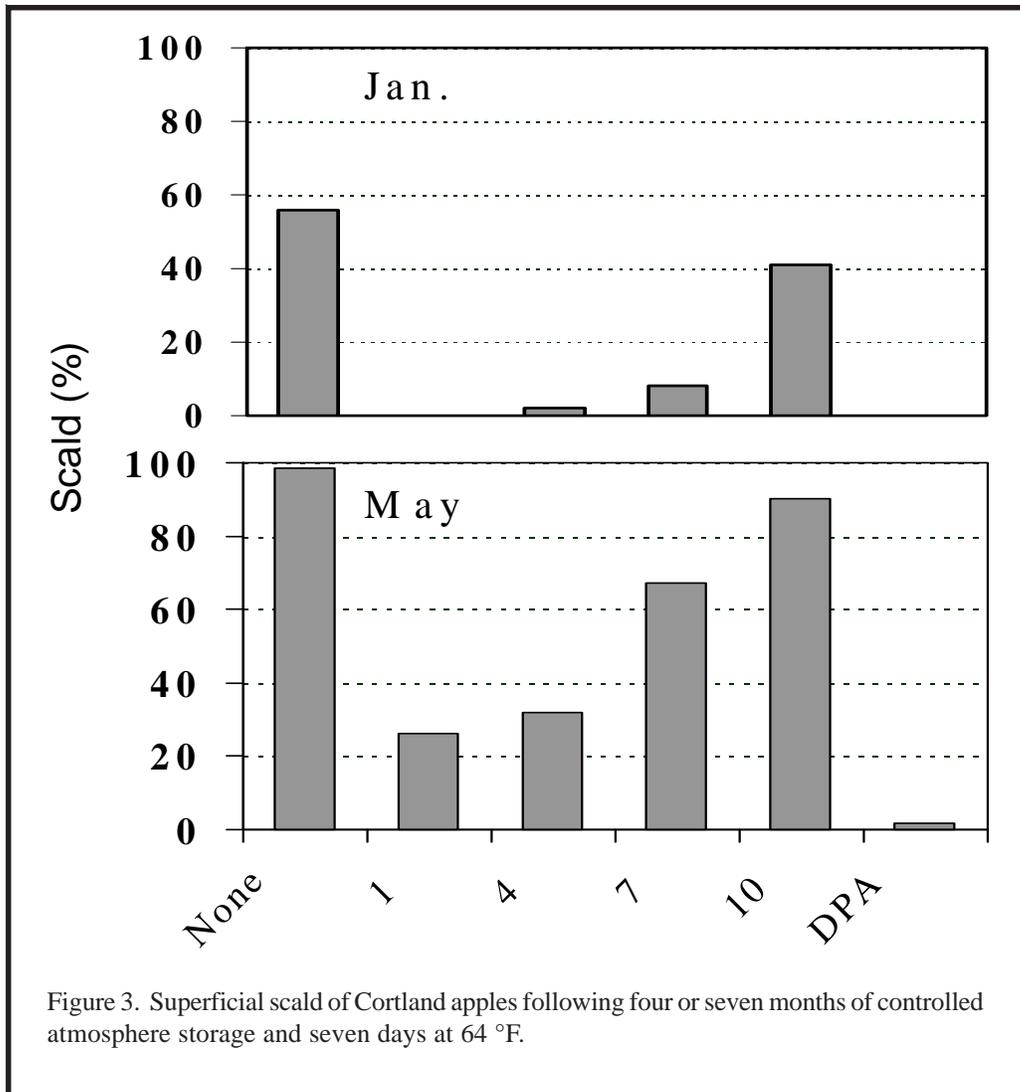
Figure 2. Firmness of McIntosh and Cortland apples following four or seven months of controlled atmosphere storage and one day at 64 °F.

maintained firmness near 16 lbs. Effectiveness in maintaining firmness dropped slightly when applied at later times, but SmartFresh was still effective when applied ten days after harvest. Firmness of these apples was about 14 lbs. Similar results occurred after seven months of storage.

Firmness of Cortland fell from 18.6 lbs. at harvest to 12.4 lbs. in untreated fruit after four months storage. Firmness remained near 17 lbs. when treated with Smartfresh one day after harvest. Application four days after harvest was as effective as application one day

after harvest. By seven days, there was a slight drop in efficacy. SmartFresh effectiveness declined further when it was applied ten days after harvest compared to earlier times, but they were 1.5 lbs. firmer than the untreated fruit. Similar results occurred seven months after storage.

Superficial scald did not occur in McIntosh after four months of storage. By seven months, it occurred in less than 1% of the untreated fruit. Scald did not occur in McIntosh fruit treated with SmartFresh or DPA.



Cortland developed severe scald after four months (Figure 3). SmartFresh prevented scald when applied one day after harvest, but not when applied at later times. With application at four days after harvest, 2% of the apples developed scald. With later application times or longer storage durations, scald was more severe and was not effectively controlled by SmartFresh. After seven months of storage, none of the SmartFresh treatments was effective in preventing scald. DPA completely prevented scald after four months. By seven months, 2% of the DPA-treated fruit had scald.

For effective control of scald in Cortland, drenching with an antioxidant is needed.

SmartFresh was most effective in maintaining firmness of McIntosh when applied one day after harvest, and was most effective with Cortland when applied one to four days after harvest. However, it was still helpful when applied as late as ten days after harvest in both varieties. This study has demonstrated that SmartFresh can maintain firmness when applied as late as ten days after harvest, but maximum effectiveness occurs with more rapid application.

