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# 1-MCP and Fruit Quality

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Thanks to the inventors and the researchers who quickly recognized the potential of 1-MCP technology (brand name SmartFresh™), it is well on its way toward earning its reputation as a very important quality maintenance tool. 1-MCP is being described as a breakthrough in fruit storage and shipping technology that can maintain the “fresh-picked” quality of ethylene sensitive fruits and vegetables. Ultimately, it will support the produce industry’s efforts to ensure consumers have a consistently good eating experience, a key element leading to increased per capita consumption of fresh fruits and vegetables.

Many research trials have been undertaken and are providing invaluable direction for our commercial focus. Research is underway around the world to measure efficacy and gauge benefits on a variety of fresh produce items, many of which will be explored in this issue. It is important to emphasize that the cold chain continues to play a primary role in maintaining fresh, safe fruits and vegetables.

In apples, the benefits of 1-MCP include maintenance of critical taste components – firmness and titratable acidity, or in consumer’s language – apple crunchiness, taste and juice content. For green veg-

etables, it’s maintaining freshness and green color. In tomatoes and melons, the data is showing 1-MCP’s ability to allow further ripening for optimal flavor development, and then maintaining that “field ripened” quality for the consumer. At the packer/shipper level, that means a better balance between the challenge of long distance shipping requirements and optimal flavor development. The benefits and value will vary crop by crop, but all hinge on maintaining harvest quality. While crisp fruits and vegetables, such as apples, cucumbers, or broccoli lend themselves easily to the use of 1-MCP, ongoing research for use on soft fruits, such as pears or avocados will be needed to develop strategies that allow the fruit to fully ripen.

## Commercialization

Registration of 1-MCP for fruits and vegetables is pending in the U.S. and is expected in time for the 2002 apple harvest. In California and New York, where state registrations can take up to a year longer, registration is expected in time for the 2003 apple harvest. We have received food use registration in Chile and Argentina, and expect to complete some commercial applications there this season with domestic apples. European Union registration will be submitted

early in 2002 and is expected possibly in late 2003/early 2004.

Registration was also received for New Zealand, though we have not yet completed our commercial plans for that market.

An easy-to-use, self contained, one-step kit is being developed for apple storage rooms, and other large-room applications. It will be fully automated; all the user will do is add water, push a button and walk away. It is a 1-time, 24-hour room treatment. When the fruit is removed from cold storage, it slowly begins ripening again. Most trials thus far have been with a 0.14% formulation, but we will use a 3.3% formulation when we are fully commercial. The 3.3% formula requires less water to activate than the 0.14% and offers a more efficient release into larger storage rooms. We expect the delivery system kit to be recyclable/returnable and the spent water disposable as non hazardous waste.

## Apples

Our data set is deepest with apples, and thus, we expect this to be our first launch. 1-MCP complements both Controlled Atmosphere and Regular Air Storage, offering benefits in both storage scenarios. The following side-by-side chart shows benefits for the apple packer/shipper in both.

**1-MCP and Controlled Atmosphere offers:**

- Better firmness with CA and 1-MCP together than individually
- Extended firmness after removal from storage
- Higher titratable acidity
- Protection from scald and greasiness
- Ability to mix varieties
- Application at broad temperature range (32-77° F)
- Treatment flexibility up to 14 days if fruit is kept in cold storage
- No need to scrub for ethylene; scrubbing of CO<sub>2</sub> needed less often

**1-MCP and Regular Air offers:**

- Firmness similar to CA up to 6 months, depending on variety
- Extended firmness after removal from storage
- Higher titratable acidity
- Protection from scald and greasiness
- Ability to mix varieties
- Application at broad temperature range (32-77° F)
- Treatment flexibility up to 14 days if fruit is kept in cold storage
- No scrubbing of ethylene; respiration reduced by 50%

Application timing is important to maintaining harvest quality. 1-MCP will not convert an 11 lb apple into a 15 lb apple. Apples should be placed into storage and 1-MCP added to the room soon after harvest in order to maintain "fresh-picked" quality. Data clearly show that in most varieties, 1-MCP can dramatically slow down softening even though fruit is well into its climacteric. However, once the apple has reached its climacteric ethylene peak, it's a runaway train and we know of no

products on the market that can stop that.

**Commercial Trial Data**

A recent trial conducted with a commercial apple packer in Washington State further demonstrates 1-MCP's effectiveness in maintaining firmness and titratable acidity. The trial consisted of 4 grower lots of Red Delicious fruit totaling 1,250 bins. After 9½ months of storage in CA, fruit treated with 1-MCP

tested at 15.7 lbs firmness, only 0.6 lbs less than their initial firmness at harvest (fig.1). Treated fruit stored for 9½ months in RA tested at 13.7 lbs, a firmness loss of 2.4 lbs from harvest which is similar to the loss in control CA fruit (fig 1).

In the same Washington State trial, fruit treated with 1-MCP tested higher than control fruit for titratable acidity after 6 months storage in both CA and RA. (fig. 2).

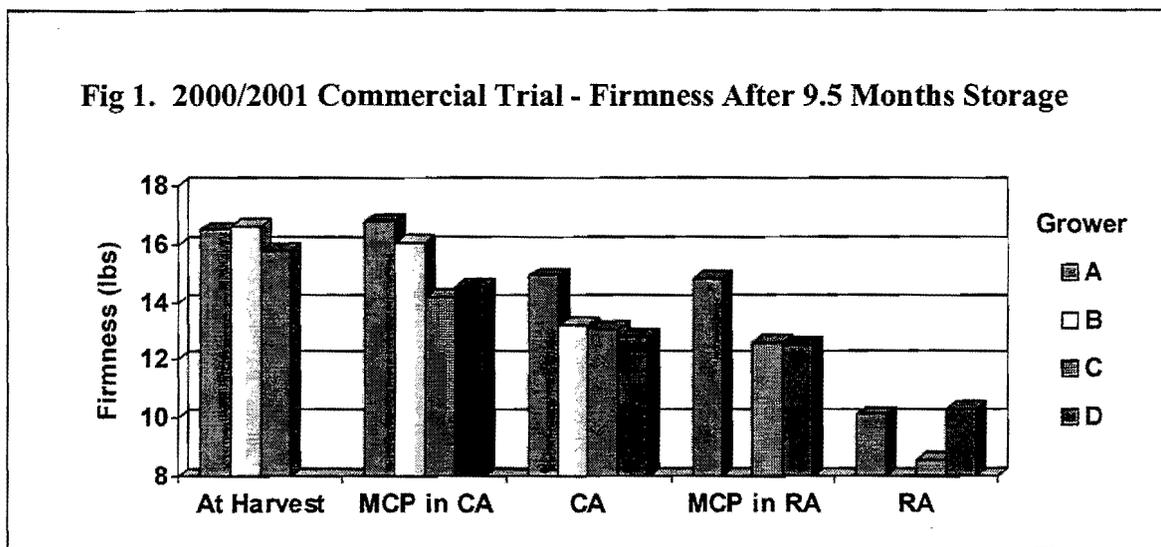
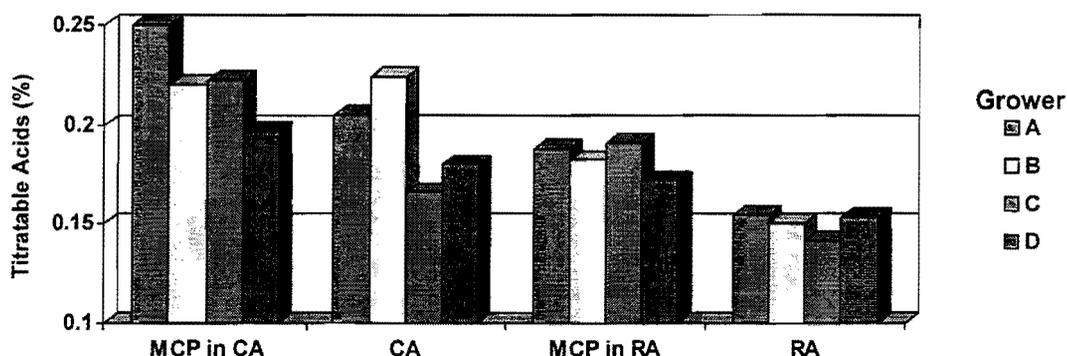


Fig 2. 2000/2001 Commercial Trial – Titratable Acidity After 6 Months Storage



The use rate is very low for 1-MCP, it has a non-toxic mode of action, and it is similar to the naturally occurring plant substance ethylene, giving it a very favorable safety profile. Studies demonstrate residues in apples are extremely low at below 5ppb. As an added benefit for apples, MCP also offers

scald protection, delivering an alternative to current antioxidant treatments.

Semi-commercial and research trials conducted in various parts of the world indicate that 1-MCP offers dramatic results in firmness and titratable acidity, as

well as protection from certain physiological disorders. A breakthrough in postharvest storage technology, 1-MCP will afford many fruit and vegetable industries the opportunity to deliver consistently high quality produce safely to the market. These benefits should be apparent all along the food chain.

## Use of 1-MCP on Apples

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Many processes that occur during apple ripening, such as softening, yellowing, increased respiration and aroma production, are closely associated with ethylene. Senescence, the irreversible physiological changes that lead to cell death, follows ripening. While many of the ripening-associated processes that occur result in providing an acceptable product to the consumer, the goal of the storage operator is to reduce ethylene responses. Control of the onset and/or continuation of ripening and se-

nescence provides the industry with a mechanism to maintain fruit quality. In fruit storage, management techniques used to minimize the effects of ethylene include low  $O_2$ , high  $CO_2$ , and reduced temperature.

### Apple responses to 1-MCP

A single exposure to 1-MCP can inhibit apple fruit sensitivity to ethylene. 1-MCP delays the onset of

the rise in ethylene production and similarly delays the rise in respiration, aroma production, and softening (Figure 1). A single post-harvest application could prevent ripening for an extended period (> 30 days), even at ambient temperatures (25°C, 77°F). 1-MCP also can inhibit aroma production in apple fruit and reduce the incidence of the storage disorder, superficial scald.

The response of apple fruit to 1-MCP depends upon a number of