Ethephon spray applications on PremA96 apples 2023 {#sec-ethrel}

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Summary

Remarkable growth in Malus domestica 'PremA96' plantings in New Zealand is leading to logistics pressures at storage facilities and the packhouse. Multiple actions can be brought into practice to streamline and ease these pressures, including using growth regulators such as the ethylene-producing compound ethephon (which triggers maturation, ripening and senescence in fruit) and the compound that inhibits ethylene's action, 1-methylcyclopropene (1-MCP). Both these compounds can be applied in the orchard as spray treatments, and both have physiological effects on the fruit that may continue into storage. Ethephon spray treatments (Ethin™, containing 480 g/L chlorethephon) may bring the start of harvesting forward by a few weeks, while the research last year on the spray application of 1-MCP-containing Harvista™ 1.3 SC proved it could delay the end of the harvest period by up to 4 weeks.

Ethephon treatments at two doses (applied at 200 and 500 mL/ha) were applied two or three times in test blocks on 'PremA96' trees in January 2023. Fruit maturity was tracked on a weekly basis to determine optimum harvest windows and to follow how fruit quality changed. One 200 mL/ha block furthermore received two Harvista spray treatments to determine how 1-MCP treatment can influence Ethephon treatment. Apples were harvested weekly from 11 January to 4 April 2023 and placed in regular air (RA) or controlled atmosphere (CA) storage after a SmartFresh™ treatment for 3 and 6 months to determine how these growth regulators affect storage performance of the apples.

The key findings of this trial were:

- Ethephon treatment brought the recommended harvest date forward from 21 February to as early as 30 January, depending on application number and dose. The harvest window (when average starch pattern index (SPI) was 3–4) was longer for Ethephon-treated fruit compared with unsprayed fruit. The timing of application may be more important than the number of spray applications, since little difference could be measured between blocks that received two and three applications.
- The lower, label-recommended dose of 200 g/ha Ethin moved the recommended start date of harvest forward by only a week relative to untreated controls, and there was considerable overlap with the time when unsprayed fruit could be picked. It is unclear whether this dose can have a stronger effect if applied earlier.
- Following Ethephon treatments with Harvista sprays can slow ripening down again, therefore fruit could be picked from the same time and up to 2 weeks later than the control fruit (21 February to 14 March). These fruit stored better than just Ethephon-treated fruit.

- Ethephon treatments resulted in fruit with different traits than unsprayed fruit when their SPI was 3–4. Fruit firmness was higher than control fruit during their recommended harvest times. Dry matter content was lower in Ethephon-treated fruit, but soluble solids concentration (SSC) was similar. The implication is that earlier harvests deprive fruit of the opportunity to accumulate structural carbon, although SSC is similar between control and Ethephon-treated fruit.
- Fruit permeance decreased as the fruit matured. Picking any fruit earlier (Ethephon-treated at correct maturity, or immature unsprayed fruit) increase the risk of shrivel symptom development in storage.
- Storage tests revealed that Ethephon does have a negative effect on the times fruit can be stored. The most important quality parameter affected was shrivel symptom development. Up to 30% more Ethephon-treated fruit would develop shrivel compared with unsprayed fruit in the same storage environment.
- Internal ethylene concentration (IEC) and SPI changes correlated with each other, proving that SPI alone can be used to judge when fruit are ready for picking.

Introduction

Ethephon (2-chloroethylphosphonic acid) is one of the most commonly used plant growth regulators that can promote pre- and postharvest ripening. After being absorbed by the plant, the molecule is metabolised and ethylene is released. In addition to ripening, ethylene can induce abscission, flower induction and leaf senescence [@wang_aminoethoxyvinylglycine_2001]. In order to limit these effects, Ethephon is often applied in conjunction with the synthetic auxin plant hormone naphthalene acetic acid (NAA). NAA is known to prevent premature fruit dropping by inhibiting abscission. It can help to limit leaf drop as ethylene concentrations increase in and around the trees after Ethephon application, but likewise accelerates ripening in apples [@ozturk_effects_2019]. Additionally, it may exacerbate russet in susceptible apple cultivars [@jones_reservations_1991].

The benefits of exposing apples (Malus domestica) to ethylene during the later stages of their development include improved colour development and being ready for harvest earlier. This could help to ease picking pressures during the harvest window. But once ripening has sped up, senescence will follow. The implications of this include the fact that the apples may not be stored as long as otherwise could be expected, with storage and aging disorders more likely to develop. 1-Methylcyclopropene (1-MCP) technologies such as SmartFresh™ and Harvista™ could help to slow senescence again, but since the processes have already started in the orchard, these mitigations will have limited effects [@mair_s_effect_2021].

The aim of this project was to track fruit ripening in the orchard for a period after Ethephon spray applications, and to determine how well the fruit stored after the various treatments. Multiple application regimes were tracked, with two dosage concentrations applied to different blocks in the same orchard. In addition, one block received a Harvista spray treatment after